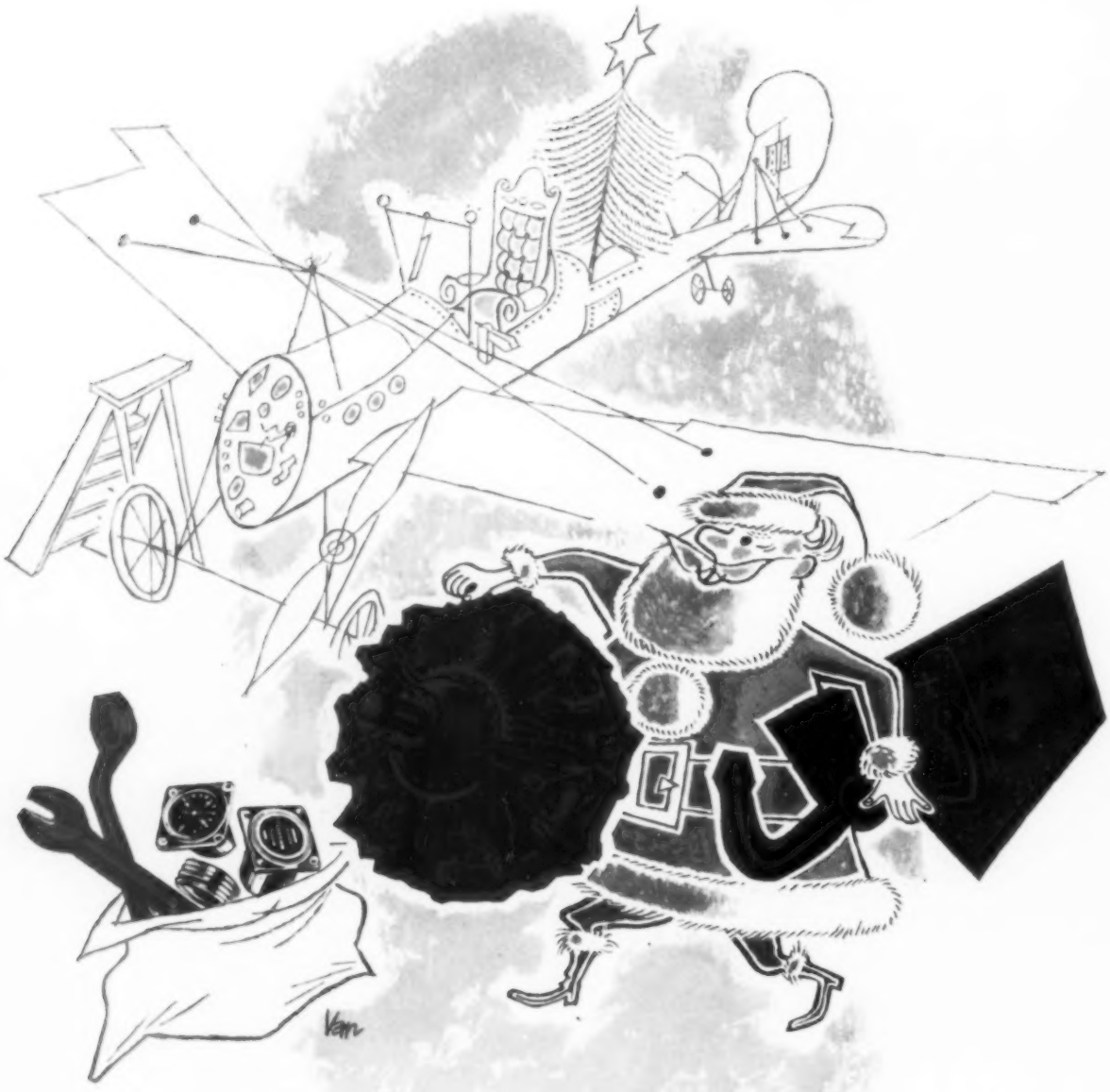
DECEMBER 1957

ONE SHILLING & SIXPENCE

FLIGHT

Vickers
wish their friends all over the world a Merry Christmas



Here's to the maintenance of our good relations in 1958

FIELD AIRCRAFT SERVICES LIMITED

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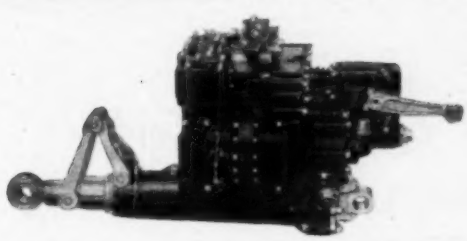
POWER FLYING CONTROLS

by

Hobson

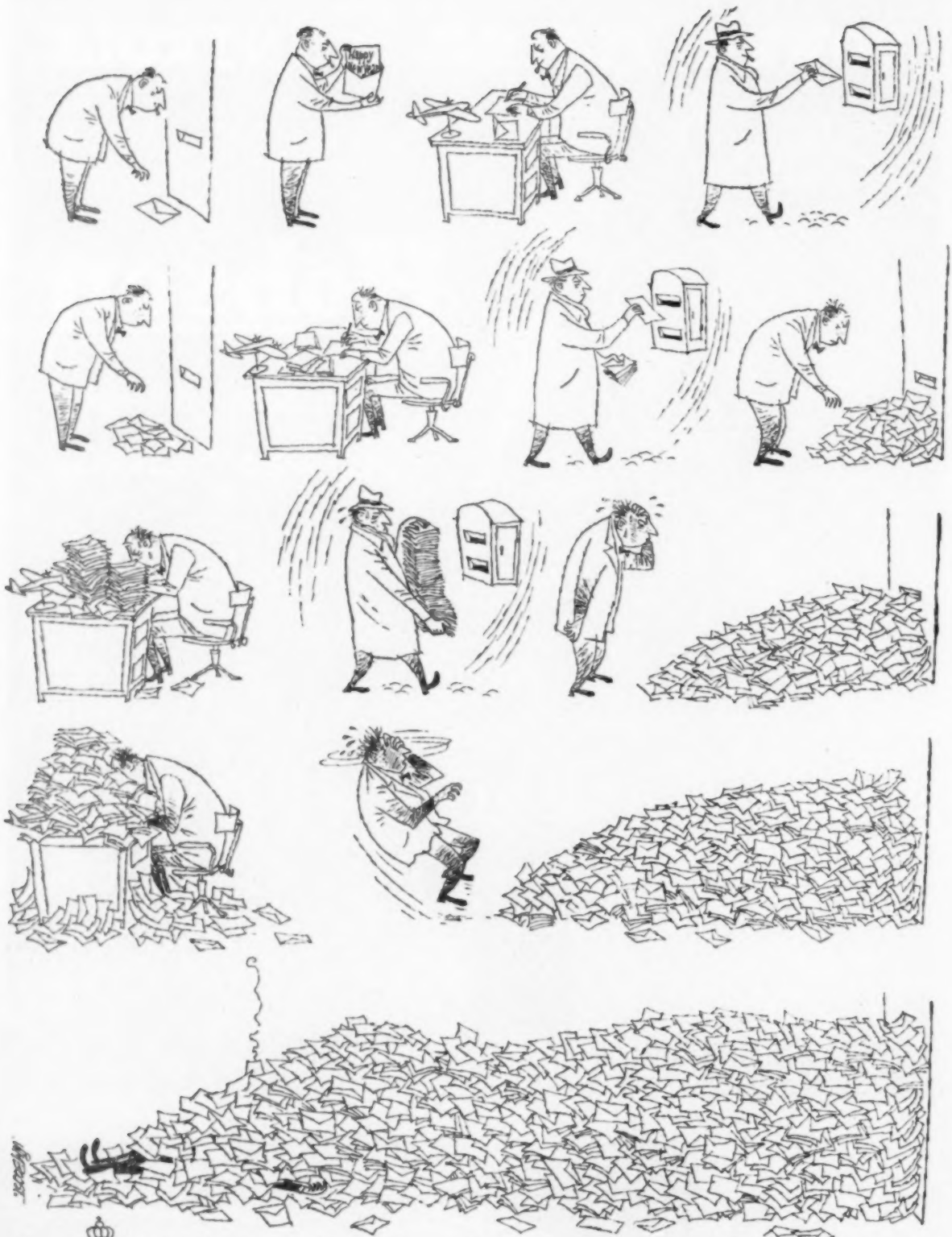
selected for the 'Gloster Javelin'



Many of Britain's leading aircraft designers are now specifying Hobson Power Flying Controls for operation of the primary control surfaces, including "All-Flying" or "Slab" tailplanes. The duplicated hydraulically operated single screw jack unit, as illustrated, is typical of Hobson units fitted to the Gloster Javelin.

H. M. HOBSON LTD · FORDHOUSES · WOLVERHAMPTON

A


..hence Fokker takes this opportunity to wish everybody a merry Christmas a very happy New Year
and lots of Friendship

BRITISH ALUMINIUM FOR NAVAL AIRCRAFT

Fairey "Gannet", the most advanced concept of an anti-submarine aircraft in the world, is in service with the Royal Navy and the Royal Australian Navy and has been ordered for Western Germany's Naval Air Arm. Materials for the construction of this aircraft are supplied by British Aluminium.

The BRITISH ALUMINIUM Co Ltd

NORFOLK HOUSE ST JAMES'S SQUARE LONDON SW1

A.P.84

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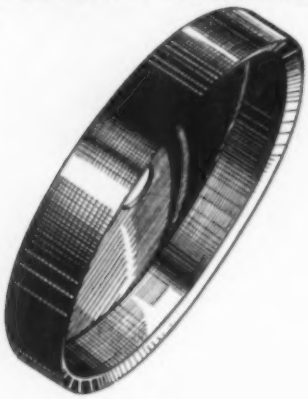
Leather Packings



VIM Leather Packings form a vital part in the operation of hydraulic, pneumatic and other mechanisms.

Resistant to oils, acids, gases, sea-water and high temperatures, they are guaranteed to last at least twice as long as any other leather packing for similar service.

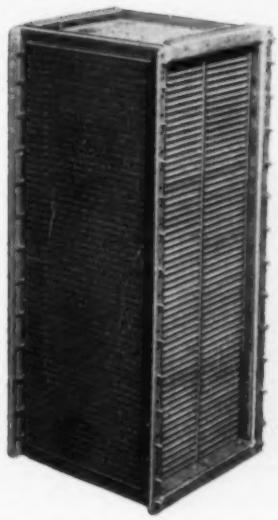
We have in Birmingham a Leather Packings Division including a well-equipped factory engaged in the production of the celebrated VIM Leather Packings. Precise methods of manufacture, high quality of materials and rigid inspection are maintained.

A Service Engineer would gladly co-operate

Edgar Vaughan & Co. Ltd.

Leather Packings Division
BIRMINGHAM - 4 - ENGLAND

Successful Heat Transfer and Heat Insulation



We design, manufacture and supply heat exchangers for many purposes in both aluminium alloy and stainless steel. This particular example is for the Vickers Viscount's anti-icing system. Similar units are supplied for the Fokker Friendship and the Bristol Britannia.

This thermal blanket is in refractory fibre cased in ·004 inch (·1016 mm.) stainless steel. It was made-to-measure, and is extremely light, the dimpled construction being responsible for its great strength. Specified for Rolls-Royce and Armstrong Siddeley jet and turbo-prop engines. Approved by the A.R.B. This example will be used on the Rolls-Royce Thrust Reverser of the de Havilland Comet.

SUCCESS in our business doesn't merely mean the ability to manufacture, though we are extremely well equipped, even to the extent of having our own aluminium flux bath brazing plant.

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Telephone: GLAdstone 2201.

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for Pete's sake pipe down about Pacitor...

Oh, pardon me, but I *am* trying to concentrate on your cricket game. Say, what the heck are they clapping for now?

Look at the scoreboard, man. Chap's got his fifty up. The only reason I mentioned Pacitor in the first place was to prove a simple point. In aviation we think we're pretty efficient. For instance, I said, the Pacitor Fuel Gauge.

Uhuh. Now what are they clapping for?

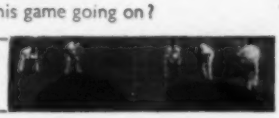
Change of bowler. Why the tank unit weighs less than a cricket ball . . . the whole contraption only 1 lb. 8 ozs. Indicator, oscillator and rectifier are all built in. It's beautifully light and servicing's easy.

O.K. O.K., it's the greatest. Holy Mackerel! They've started clapping again.

Course they have . . . 100 up. And there's no need to get shirty. All I'm saying is that with a thing like Pacitor the British prove they have the 'know-how' on aircraft fuel tank gauges.

Uhuh. Say, how much longer is this game going on?

Only a couple of days . . .



the point of the argument . . . PACITOR FUEL GAUGES

For more details of this and other products for the aviation industry SEND FOR LITERATURE to

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(a subsidiary of Simmonds Aerocessories Ltd.)
Byron House, 7-8-9, St. James's Street, London, S.W.1

Head Office & Works: Treforest, Pontypridd, Glamorgan.
Also Birmingham, Manchester, Glasgow, Stockholm, Copenhagen, Ballarat, Sydney, Johannesburg, Amsterdam and New York.

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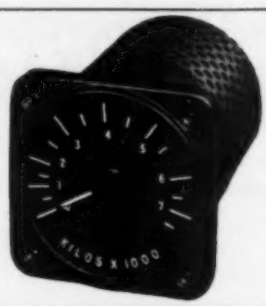

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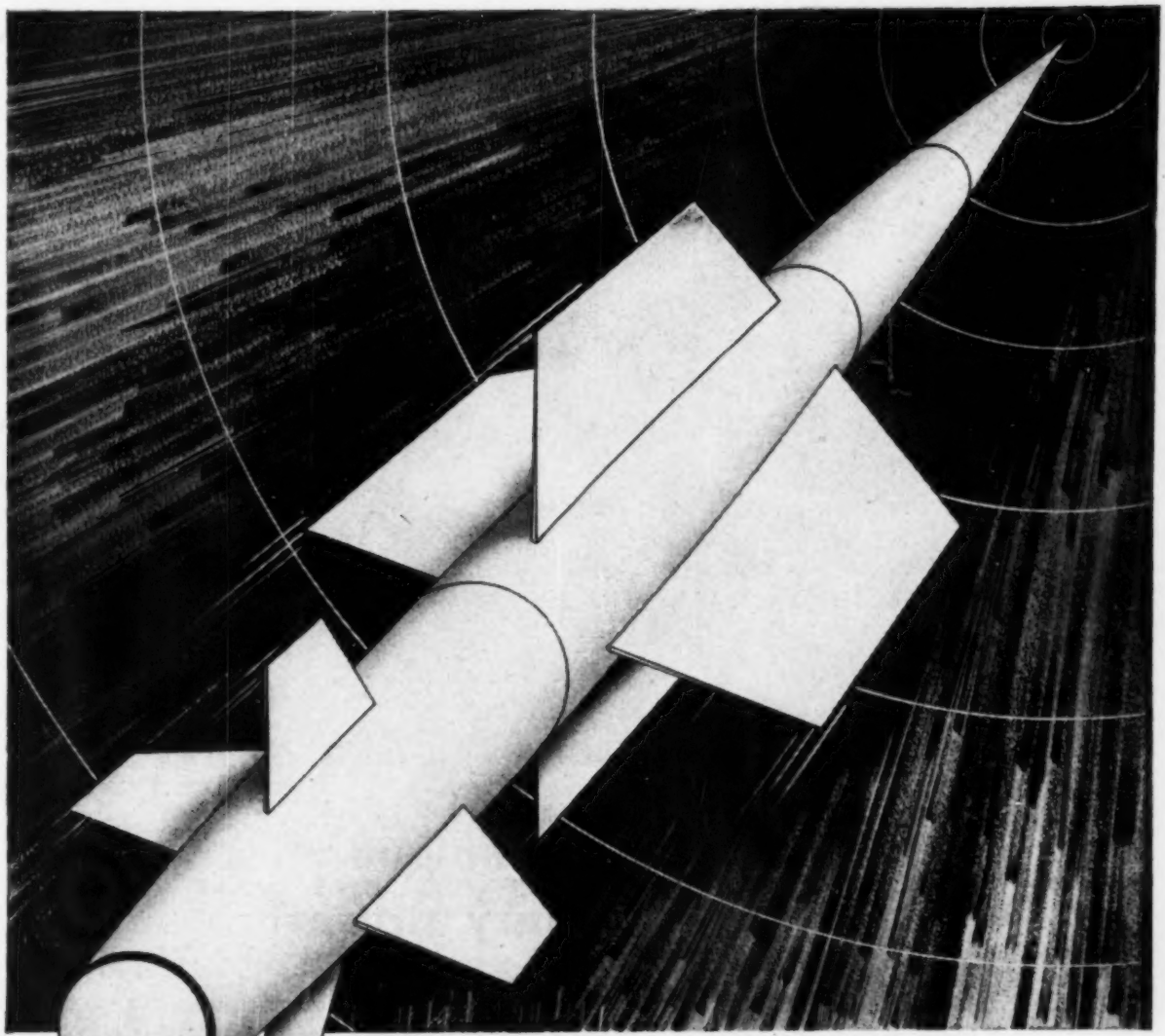

impact

Continuous and ever-increasing research, backed by the unique facilities of the largest organisation of its kind in the world, is enabling the Guided Weapons Division of Elliott Brothers (London) Ltd. to make a unique and vital contribution to the development of homing systems. Intensive system study, including simulation with Elliott analogue computers, has led to immediate success with a number of very advanced practical designs.

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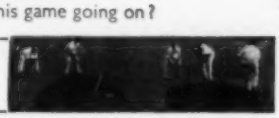

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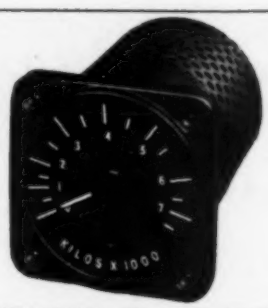

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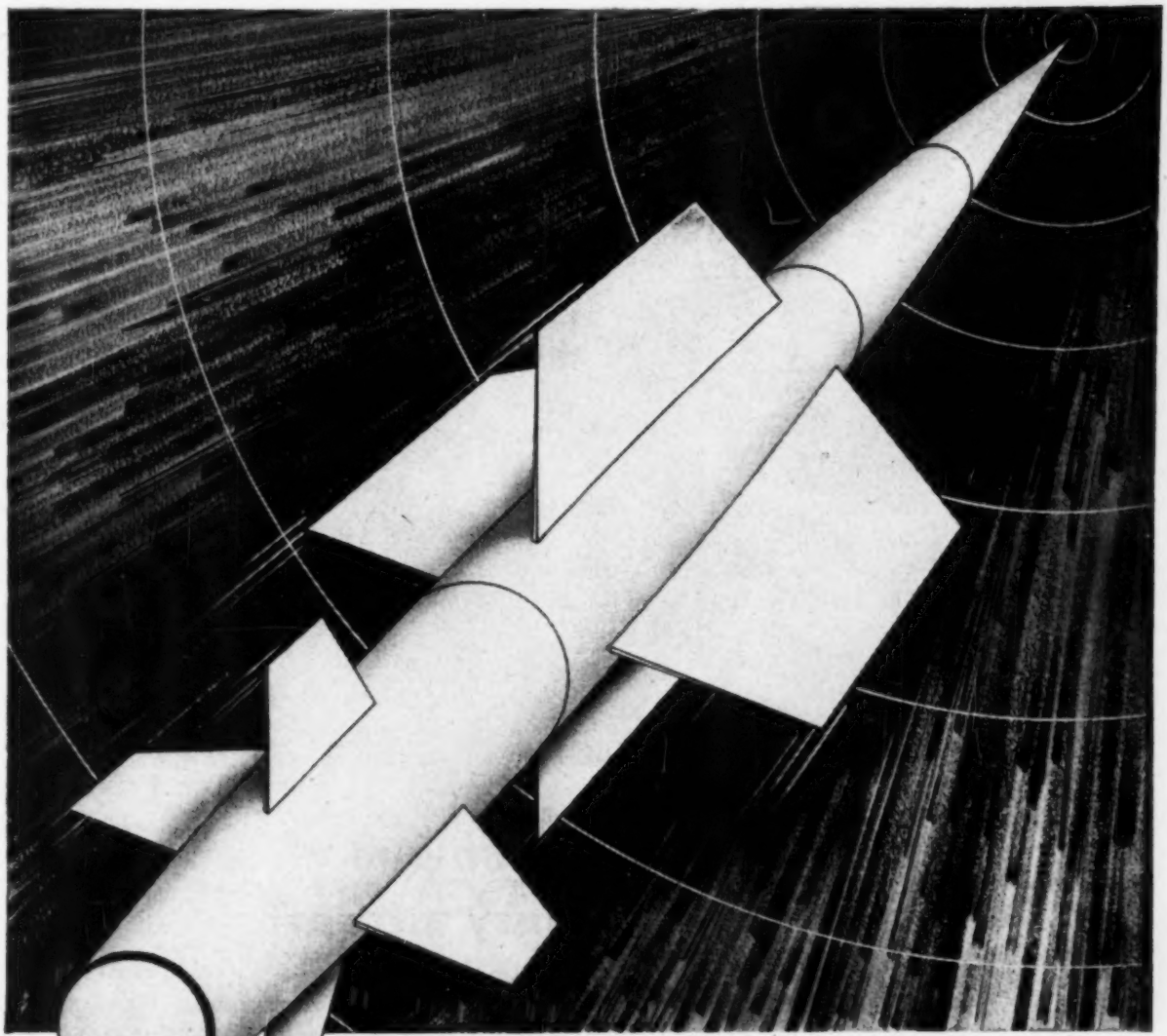

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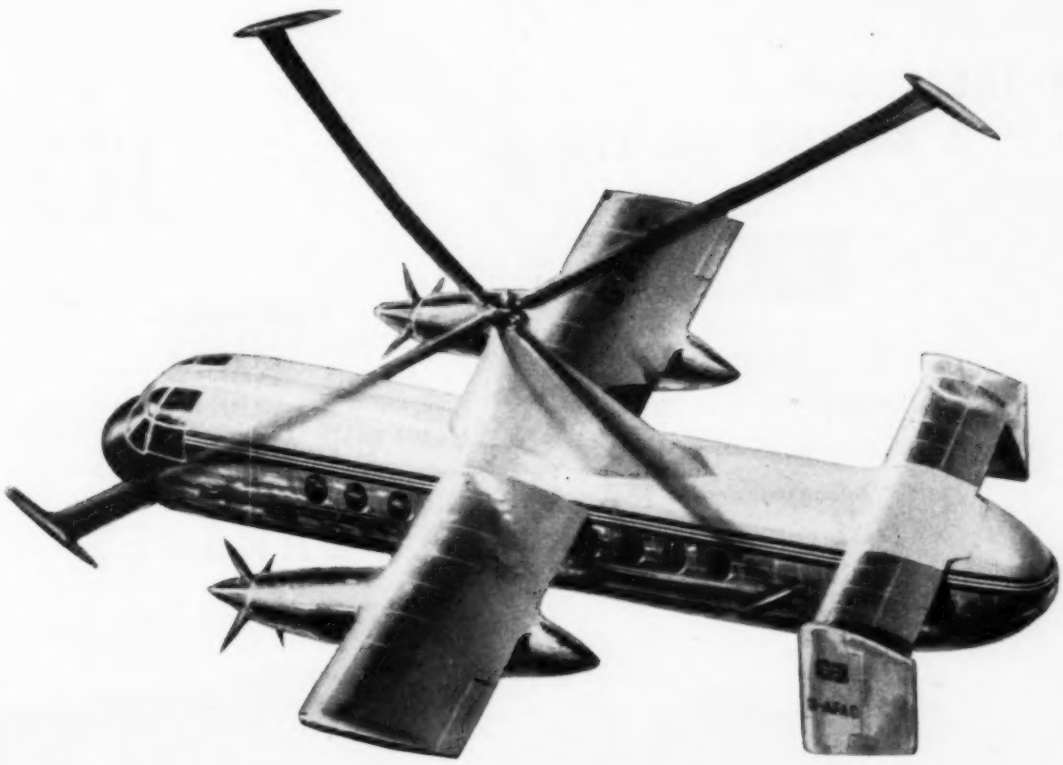

It's 'FLEXELITE' for Fairey's Rotodyne

Fairey's Rotodyne is a new departure in helicopter design.
For city-to-city freight and passenger flight it calls for the highest safety standards in all associated equipment. So Fairey's chose 'Flexelite'—
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and are proud to have contributed to some of the most important components of the rotor assembly and under-carriage.

The leading edge spars of the rotor blades are machined from what are believed to be the longest heat-treated bars of high tensile steel yet produced. Special equipment was developed by English Steel Corporation Limited to heat-treat the bars to a tensile strength exceeding 70 tons per square inch, whilst keeping them perfectly straight, as no subsequent rectification could be permitted.

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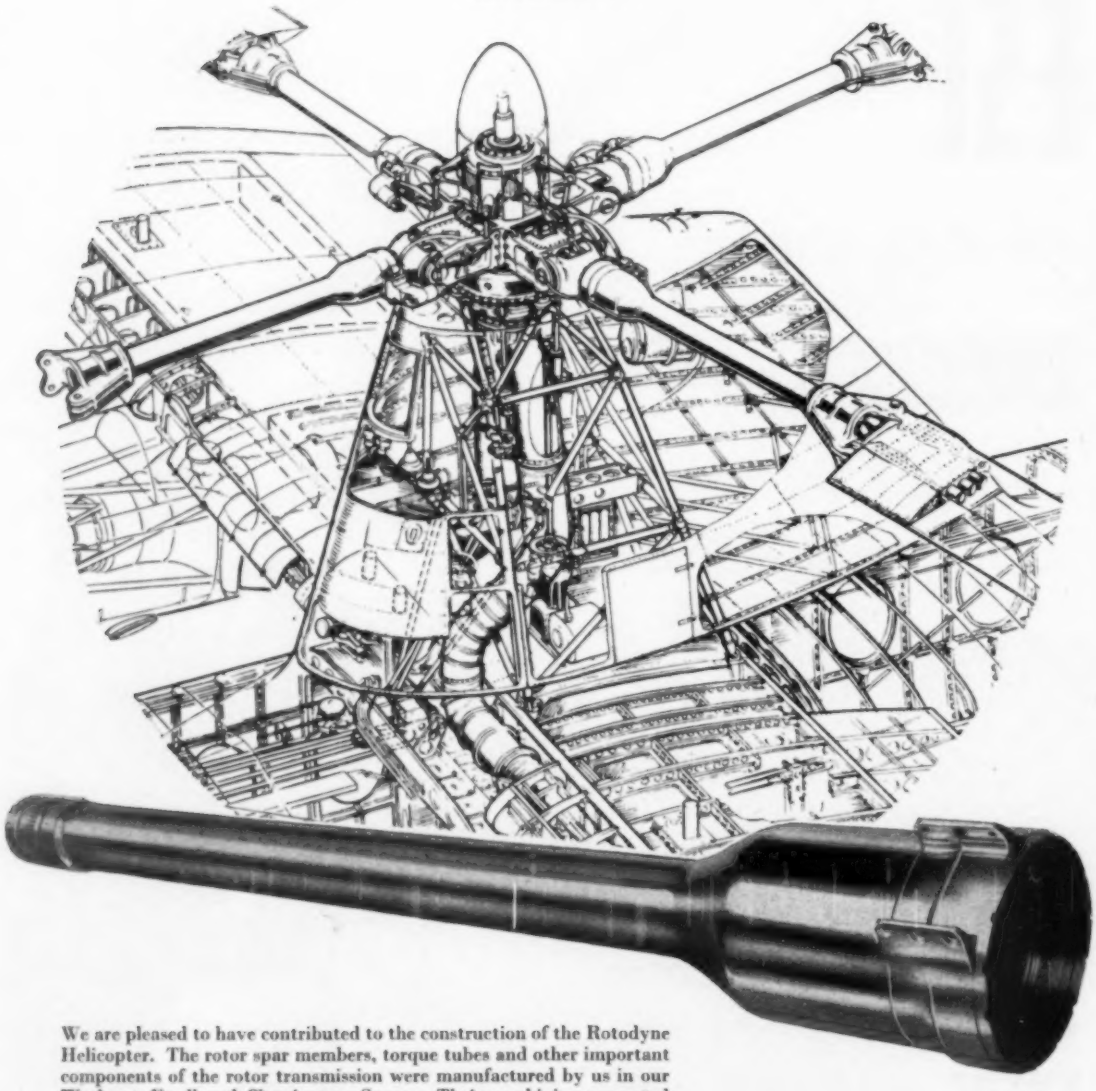

We are pleased to have contributed to the construction of the Rotodyne Helicopter. The rotor spar members, torque tubes and other important components of the rotor transmission were manufactured by us in our Works at Ewell and Chessington, Surrey. Their machining presented many unique problems, the solution of which is our proud contribution to this fine British venture.

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HYLITE 10 TITANIUM ALLOY	Commercially pure titanium, supplied to D.T.D. specifications 5013 and 5033. Resistance to corrosion with maximum formability and weldability where strength is not critical.
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HYLITE 20 TITANIUM ALLOY	5% aluminium, 2½% tin alloy. An alpha alloy of moderate strength. Being readily weldable and easily formed is suitable for sheet metal work where higher strength than Hylite 10 is required.
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Properties of Jessop Hylite Titanium Alloys

Composition	0.1% proof stress tons/sq.in.	U.T.S. tons/sq.in.	Elongation %	Hardness B.H.N.
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Commercially pure titanium (hard grade)	23.0	34.0	25.0	160
5% Al., 2½% Sn.	46.0	56.0	18.0	270
2% Mn. 2% Al.	36.0	44.0	20.0	240
4% Mn. 4% Al.	58.0	62.0	18.0	300
6% Al. 4% V.	58.0	63.0	22.0	300
Complex Al. alloy	64.0	72.0	15.0	360

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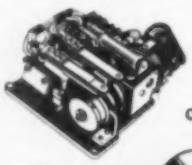
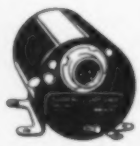
Time Switches—non-resetting, resetting and cycling, are widely used on many of to-day's aircraft for such applications as; gas turbine engine and rocket motor starting  inching mechanisms for power operated flying trim controls, camera gun operation, navigation light flashing units, civil  and military; de-icing heater mat cycling units automatic bomb release switches and units designed to provide a fixed duration pulse at selectable intervals.

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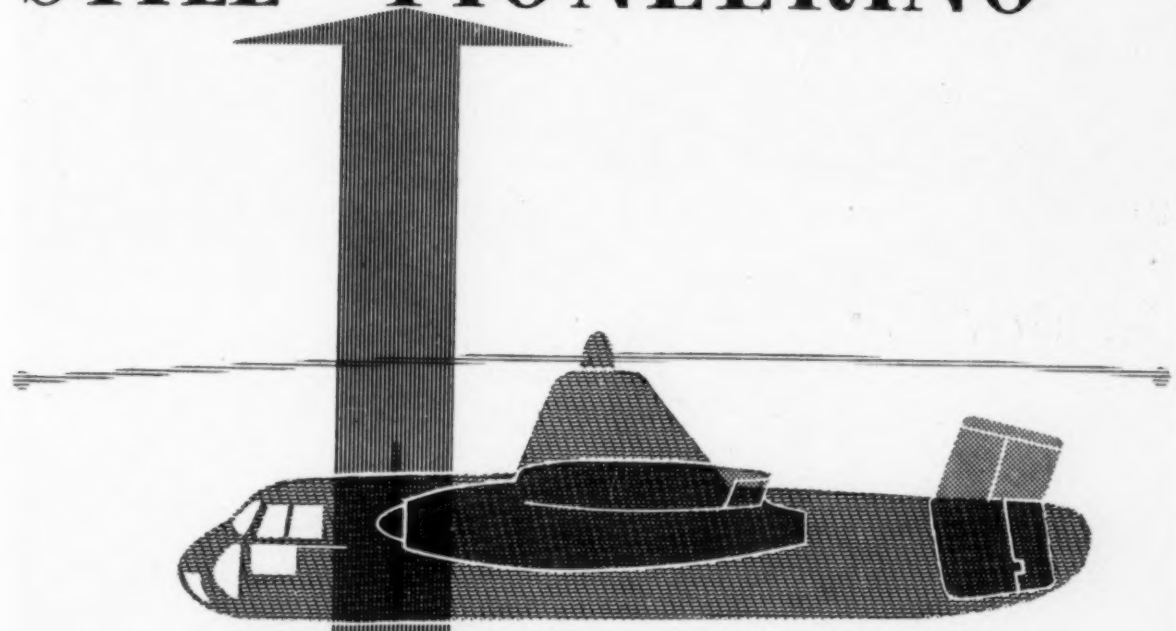

into New Fields

The continuous technical development of special stainless, heat and creep-resisting steels carried out by Firth-Vickers since the early days of aviation, has made possible the continual improvement in performance and efficiency both of airframes and engines upon which Britain's lead in aeronautical achievements are based.

Staybrite stainless steel was supplied for the Rotodyne rotor blades specially cold rolled to give high tensile strength and yet leaving sufficient ductility for forming. This is another case where collaboration between steel maker and aircraft designer produces success with the right steel for the right job.

FIRTH-VICKERS STAINLESS STEELS LTD. · SHEFFIELD

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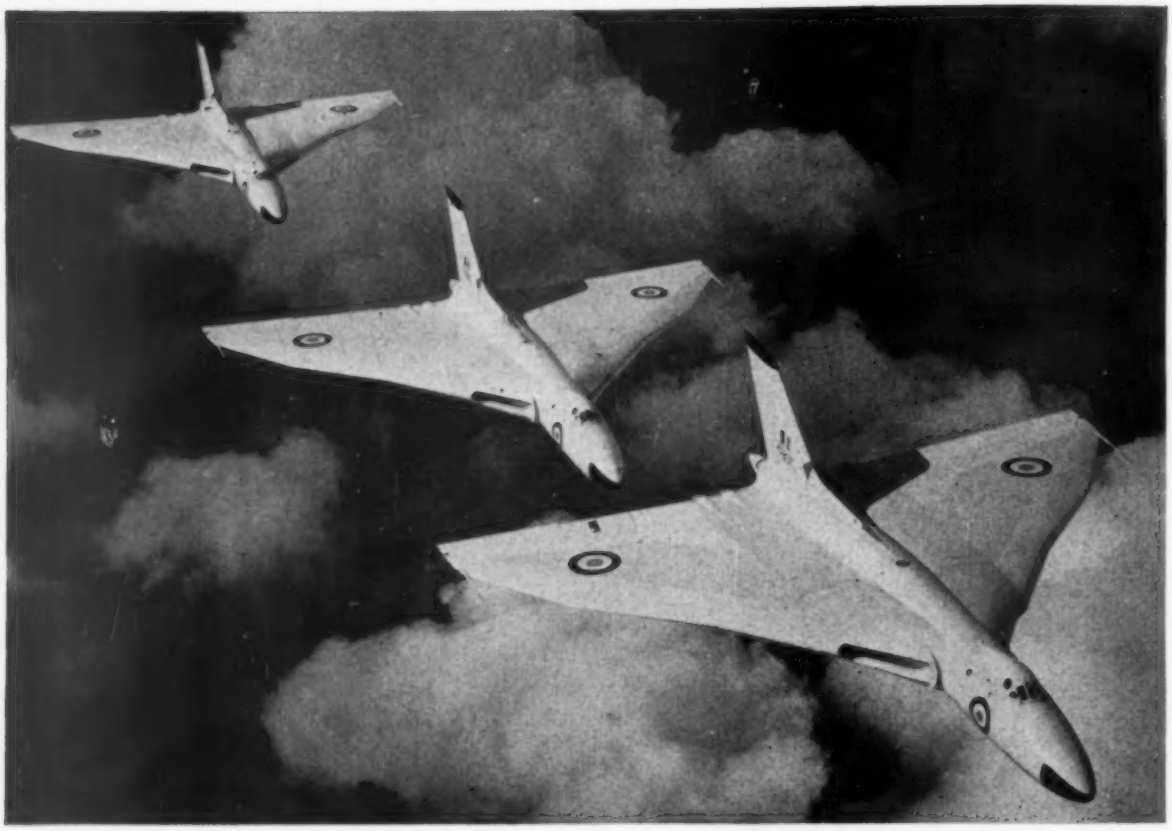

"Equal to, if not better than, any Bomber in the World"

—Mr. C. I. Orr-Ewing, Under Secretary for Air.

In announcing that the famous 617 Squadron—the Dam Busters—is to be reformed and equipped with the Avro Vulcan Delta Bomber, believed to be the fastest bomber in service anywhere, Mr. Charles Ian Orr-Ewing, Under Secretary for Air, has said that in the Vulcan "we now have a bomber aircraft which is equal to, if not better than, anything else in the world".

"The Vulcan comes from a good stable"

In addition to Mr. Orr-Ewing's tribute, the Air Officer Commanding No. 1 Group, Bomber Command, had this to say: "We are extremely pleased with the Vulcan, both from the operating and the maintenance aspects. The way in which this large aircraft and its complex system has been brought into use in the front line of Bomber Command, without any of the enforced groundings so frequently experienced with new types of aircraft, is most gratifying. The Vulcan is giving us splendid utilization; indeed, it is far better than we experienced with any other type of aircraft, large or small. The Vulcan comes from a good stable and is liked by the servicing crews as well as the flying crews."

We are proud of our stable—from it have come: *the Avro '504'—the first long-range bomber of World War 1; the faithful Anson; the immortal Lancaster, used by the Dam Busters in World War 2; and . . . now the Vulcan.*

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and
AIRCRAFT ENGINEER

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964 Leaves from a Line-book

A Toast to Turbulence

ONE requirement of an aeronautical journalist is that he should equate the particulars of aeronautics with the generalities of journalism. Thus, when we remark that at Christmas 1957 our thoughts are much with the binders, we have in mind not only those part-time or professional critics who are constantly inveighing against the shocking state of British aviation, but those quiet and tidy souls who are gathering up all the loose *Flights* (with all the fervent strictures duly on record) between neat blue covers.

Aeronautically, of course, the verb "to bind" has special associations; for, although to the engineer it may denote dangerous friction, the inheritors of the P/O. Prune and A/C. Plonk tradition still cherish the bind as their inalienable right for attaining (generally) relief and (occasionally) redress. Remarkably enough, it is in the austere, uncompromising field of aerodynamics that positive benefits are everywhere being demonstrated by neat little binding devices (decently called turbulators) which, by stirring up the stagnant boundary layer, contribute most usefully to control and stability. And so it should be, we think, with the critics of the aircraft industry. A few turbulators busily at work in the areas of Westminster, Whitehall and Fleet Street can do a power of good.

A little induced burbling, of course, is one matter. Quite another is the ploughing-up of public feeling and the setting on-edge of public teeth with the rat-tailed file that so often passes for incisive comment. Contrast the rasping, cross-grained, binding action of this implement with that of the turbulator. The file, by nature, is a tool for "revealing." It "reveals" with sickening frequency that military aircraft are all but extinct; that research is already being ruthlessly and irrevocably slashed; that British civil aeroplanes (the Viscount excepted) are the butt of the world; that there is too much (or too little) planning; that only the big-time old-established firms can stand the pace; that the little man is going to the wall . . .

The turbulator, if judiciously applied, would trace the changing pattern of the industry by indicating exactly what is happening and why. It would affirm the enduring need of manned aeroplanes for manifold duties and in new circumstances. It would point to the imperative necessity for continuity of research—without setting up a wail as though disaster had already struck. It would show that our transports are at least competitive and at most challenging—while directing attention to new fields and new techniques. It would affirm that rationalization means neither neutralisation nor nationalization. And it would show that the little man is not yet cringing in the shadows of crumbling monoliths.

So our Christmas toast is to turbulence—and may Marley's ghost pay a seasonal call on all binding Scrooges.

Should the boffins start arguing at this point that the turbulator is a parasitic excrescence, then we can only reply that so is mistletoe. And think how useful that is.

With which thought we wish all readers

A Merry Christmas
and a
Happy New Year

TEST FACILITIES for the development of Bristol helicopters. On the left is the first of two rigs built to develop and test the engines, transmission and rotor-head systems for production versions of the Type 192 helicopter. On the right is the tower designed to test the dynamic and aerodynamic properties of blades. Further reference to the Gazelle-powered rig is made on this page ("Bristol 192 Test Rig").

FROM ALL QUARTERS

Voodoo's 1,207.6 m.p.h.

A U.S.A.F. McDonnell F-101A Voodoo (two Pratt and Whitney J57-13), piloted by Maj. Adrian Drew, achieved an average speed of 1,207.6 m.p.h. in two passes over a measured course near Los Angeles on December 12. Subject to homologation, this constitutes a new world speed record. The present record was set up by Mr. Peter Twiss, in a Fairey F.D.2 on March 10 last year, when he achieved a speed of 1,132 m.p.h.

Alfred Instone

AS we go to press we learn with regret of the death of Captain Alfred Instone, following sudden illness while attending a meeting of the Court of Common Council in London on December 12. He was 73 years of age.

Capt. Instone was a pioneer of commercial aviation in this country and in 1919 founded the Instone Air Line, for the carriage of mail between London and Paris. This enterprise was eventually merged with Imperial Airways, Ltd. He also had shipping interests, and in 1938 helped to form the air charter section of the Baltic Exchange.

Before the war he became chairman of the committee of the City of London Corporation, in which capacity he negotiated the purchase of land at Fairlop for the City's municipal airport project.

Studying the Industry

REPLYING to Parliamentary questions about the committee inquiring into the aircraft industry, the Minister of Supply, Mr. Aubrey Jones, said last week that its purpose was to make recommendations on future policy—in particular as to the scale on which the Government should continue to support aeronautical research. Mr. Jones said he hoped to make a policy statement on the research question "before the spring." He added that the study would certainly take account of the possibility of diversifying the industry's products; but action on that lay primarily with the industry itself.

Mr. Jones told Mr. Frank Beswick that he had not heard of any proposal that the R.A.E. at Farnborough should be closed. The establishment had a proud record and for many years had played a leading part in keeping British aviation research in the forefront. Its future importance was likely to be equally great in the new field of guided weapons.

In the Lords on December 11 Lord Mancroft, Minister without Portfolio, rejected a request for an outside inquiry into the industry. All relevant information, he said, was at the Government's disposal; and it was hoped that as a result of the searching departmental review decisions of policy on the main issues facing the industry would be announced next spring.

Bristol 192 Test Rig

AT the Weston-super-Mare helicopter centre of Bristol Aircraft, Ltd., the company's first turbine-powered helicopter ground rig, in the twin-engined tandem-rotor configuration, has begun preliminary running. Powered by two Napier Gazelle free-turbine engines, each of 1,650 s.h.p., the rig (illustrated above) is the first of two that have been built to develop and test the engines, transmission and rotor-head systems which will be used on production versions of the Bristol Type 192. Virtually a complete airframe, the rig is capable of simulating gearbox, transmission and steady flight-loads closely akin to those which will be experienced during flight. For test purposes, the rig is suspended from a gantry assembled from standard Bailey-bridge components. The gantry is fitted with a noise-reducing baffle developed by the company in conjunction with the N.P.L. Following initial tests, the rig will be subjected to intensive periods of endurance running in order to establish the reliability essential in the various systems before the Type 192 goes into service.

Whereas this first rig is operated from the cabin, a second will be operated entirely by remote control from a control caravan on the rig site, which will greatly facilitate testing over long periods of continuous running. A further rig is nearing completion for the structural and dynamic testing of controls.

After the B.E.A. Jet?

A WRITTEN answer given by the Minister of Supply on December 11 to a question put by Sir A. V. Harvey on the functions of the Transport Aircraft Requirements Committee shows a fairly complete picture of the intended pattern of British civil aircraft development over the next decade. The Committee, said Mr. Jones, has considered a medium/long-range jet for B.O.A.C. which is to be met by the purchase of 35 VC-10s; a medium/short-range jet for B.E.A., "on which I hope that an early decision will be announced"; a supersonic civil transport on which a research study is now being made; the future programme

FIRST AND ONLY component to have been removed from the original Whittle gas turbine is the battered blade seen in close-up on the right. On the left it is being presented to the Duke of Edinburgh on the occasion of his visit on December 10 to Power Jets (Research and Development), Ltd., at Farnborough. His Royal Highness is receiving the historic memento from Mr. T. G. Hicks, managing director of the company.

***JET DEFLECTION**: This is the first photograph to be published showing the jet-deflection box fitted to each of the Rolls-Royce Nene turbojets of the experimental N.G.T.E./Westland Meteor. This pioneer British device is referred to on p. 962.*

of development of the Britannia, Rotodyne and the Orion engine; and "an aircraft and an engine project which are not being pursued."

Mr. Jones also said that the Committee was giving consideration to possible requirements for a long-range freighter [several projects for which are known to be under consideration] and was considering a programme of research and development. It was also conducting a review of all possible transport requirements of the Services, Corporations and independent companies within the next ten to 15 years. The Committee, which has been meeting since November last year, consists of representatives of the M.o.S., Admiralty, Air Ministry, M.T.C.A., Treasury, B.O.A.C., B.E.A. and B.I.A.T.A.

Capt. Forsyth Retires

CHIEF helicopter engineer of the Fairey Aviation Company until the beginning of the year, Capt. A. G. Forsyth, B.Sc., F.R.Ae.S., has attained retiring age and has left Faireys after more than 45 years in the aircraft industry. He joined the company in 1931 and for the past 14 years has specialized in rotating-wing aircraft.

Capt. A. G. Forsyth.

He began his career with Wolseley Motors in 1912, and after two years in the experimental aero-engine department joined the R.F.C. and was commissioned as a pilot in No. 14 Squadron. He spent the first two years after the war with Sages on racing-car engine design, before joining the Air Ministry, in 1921, as a permanent Civil Servant.

Capt. Forsyth had gone to the Ministry to take charge of the development of liquid-cooled engines in this country and he was soon deeply engaged on such units as the Rolls-Royce Condor, Kestrel and "R" and the Napier Lion. From 1926 to 1931 he was concerned with the development of engines used in the Schneider Cup seaplanes. He designed, during 1926, the first constant-speed hydraulically operated propeller in the world, which was later flown on a Horsley.

He went to Faireys as chief engine designer in 1931, his first job being to design a liquid-cooled "V" engine, the 900 h.p. Prince, with two-speed supercharger. In the following years Capt. Forsyth's experimental engine department at Hayes produced the P.24, a 24-cylinder "H" design of two vertical 12-cylinder engines on a common crankcase. Each half of the engine drove its own propeller and could be cut out so that the aircraft flew solely on one half of the engine. The P.24 was seen by General "Hap" Arnold who immediately asked that the engine and its test-bed (a Battle) be sent to the United States for evaluation as a new powerplant to be built under licence by Ford, for the Republic P-47. Forsyth and his P.24-Battle went to Wright Field in early 1941; but, impressed though they were with the engine's performance, the Americans decided against putting it into production in the light of the urgent requirements engendered by Pearl Harbour.

In 1946 Forsyth, in conjunction with Dr. J. A. J. Bennett, started development work on rotating-wing aircraft and in 1948, the Fairey Gyrodyne, first fruit of this research, gained the world helicopter speed record at 124.3 m.p.h. The Gyrodyne's rotor was later changed for tip-jet drive for investigation of a convertiplane design. The resulting Jet Gyrodyne, as it was called, became a test-bed for the propulsive system of the Rotodyne, another design in which Capt. Forsyth played a conspicuous part, and which is discussed at length on pages 953-960.

***FIAT/BRISTOL** agreement for the manufacture by the Italian company of the Orpheus turbojet (destined for the Fiat G91) was concluded on the occasion depicted (December 9). Professor Vittorio Valletta, Fiat chairman and managing director, and Sir Reginald Verdon Smith, Bristol Aeroplane Company chairman and managing director, are seen shaking hands.*

IN BRIEF

Mr. P. C. Garratt, vice-president and managing director of de Havilland Aircraft of Canada, Ltd., and a director of de Havilland Aircraft, Inc., U.S.A., has been appointed an ordinary director of de Havilland Holdings, Ltd. He has been a special director of the parent company since January this year.

* * *

Hawker Siddeley Group financial results for the year ended July 31 show that consolidated profits increased by £3.75m to £20.6m. After charges for depreciation (increased from £3.93m to £6.34m), a special-development expenditure of £2.13m, taxation, and adjustments for previous years, the net figure is £5,535,156, or £447,523 lower than the 1955-56 total.

* * *

We regret to record the death, at the age of 59, of Mr. Paul Brewster, publicist and journalist. Among firms whose publicity he handled was the Goodyear Tyre and Rubber Co., Ltd. During the First World War he served as a pilot, and was afterwards with Lord Northcliffe and Lord Beaverbrook. His widow, Mrs. Asta Brewster, is continuing the business.

* * *

Postponement by the Swiss Government of its decision to purchase 100 Hawker Hunters (referred to in a news-item last week) is explained as due to the fact that by January the Government will be able to put its complete programme for Swiss Air Force equipment before Parliament, which can then discuss and vote on it as a whole.

* * *

Following Fiat statements that the G.91 has won the NATO strike fighter competition, a Paris report declares that the French Government will not accept the aircraft. No final NATO decision has yet been announced. From Italy comes news of a NATO design competition for an anti-submarine aircraft, either an amphibian with about six hours' endurance or a larger machine with 15 hours' endurance.

* * *

A normal-category Certificate of Airworthiness has now been obtained for the Thruxton Jackaroo, the four-seat Tiger Moth conversion produced by Jackaroo Aircraft, Ltd., at Thruxton. Two machines of this type are now on the strength of the Wiltshire School of Flying at Thruxton, and it is hoped to add two more early in 1958. Sales of the Jackaroo in this country are handled by Rollasons Aircraft, Ltd., Croydon.

* * *

Four Edgar Percival E.P.9s have recently completed 14,000-mile delivery flights to Australia from the U.K. Two of the aircraft were carrying assorted cargo (including a racing-car engine in each) and the other two carried three and two passengers respectively as well as some freight. The pilots—Messrs. A. Miller, A. J. R. Oates, E. Tadgell and J. L. Whiteman—said that no mechanical trouble of any kind was encountered on the trip. Two of the aircraft were for Superspread Aviation, Ltd., of Melbourne and the other two for Skyspread Pty., Ltd., of Sydney.

Flying the Caravelle

By VICO ROSASPINA

HERE is "Flight's" first report of the flying characteristics of the Sud Aviation Caravelle, France's increasingly favoured short-range jet airliner—a class of aeroplane which is commanding the close attention of the British industry at the present time. The author, who regularly contributes Italian news to our pages, is also a free-lance test pilot.

TO get the Caravelle moving in order to taxi out it is necessary to use the two Rolls-Royce Avon RA.29s at about 60 per cent power; they are first opened up to 5,000 r.p.m., and the correct taxying speed can thereafter be maintained with about 4,500 r.p.m. Directional control is by the steerable nosewheel, making use of brakes unnecessary; owing to the fact that the engines lie so close to the fuselage centre-line asymmetric power is not practicable for steering purposes. Rudder control becomes effective at 75 to 80 kt. Full take-off power—10,500 lb thrust at 8,160 r.p.m.—can be held on the brakes.

Cockpit layout of the Caravelle is designed to permit two-man operation, though a seat for a supernumary is provided. The windscreens and general dimensions are those of the Comet.

For take-off the best flap setting is 10 deg. Allowable c.g. travel is between 20 per cent and 35 per cent of the mean aerodynamic chord. With the Caravelle at a gross weight of 90,400 lb the nosewheel is brought off at about 7 kt below unsticking speed, which is 120 kt. Longitudinal stability, both during and after take-off, seemed good.

Forward visibility I found to be beyond criticism, but on this prototype the outlook to each side—and especially to starboard—left something to be desired; improvements are promised in the production version.

From "brakes off" the full-weight take-off run lasts approximately 30 sec at an ambient temperature of about 20 deg C, and the undercarriage and flaps can be brought fully up some 20 sec after leaving the runway. Optimum climbing speed—255 kt—is attained in 55 sec. The time taken to reach safety speed of 1.3 V_s hardly calls for consideration, as the Caravelle does not normally unstick until this speed has been passed.

In accordance with American C.A.R.4b requirements, for take-off at an airport altitude of 3,280ft a gross-weight reduction of 5,500 lb is necessary in order to achieve a take-off distance comparable with the full-weight sea-level figure. An increase of 10 deg C in airport temperature implies a weight reduction of about 2,600 lb. To put the matter another way: for operations at maximum weight these airfield conditions require, respectively, a 9 per cent increase in take-off distance in the first case and a 490ft increase in the second.

One increases optimum climbing speed progressively to

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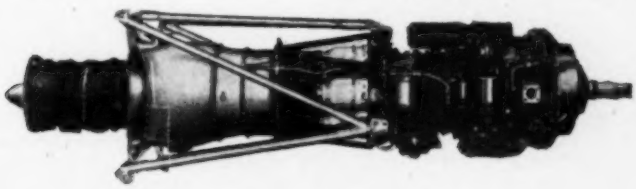
A basic factor in the selection of these engines was their ability to provide power to the propellers for forward flight and compressed air to the rotor tip jet units for vertical flight.



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THE

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has completed an official British Ministry of Supply type test in accordance with the combined U.S./U.K. test schedule at a rating of

17,250 lb. THRUST

and is in production for the

HANDLEY PAGE VICTOR BMK.2.

The British Air Registration Board have already confirmed that a civil version of the same engine has successfully completed a 150 hour test run in accordance with the combined U.S./U.K. Civil Type Test Schedule at a dry take-off rating of 16,500 lb. thrust.

ROLLS-ROYCE AERO ENGINES LEAD THE WORLD

A plan view which is likely to become symbolic of European short/medium-range jet airliners in the years ahead.
"Flight" photograph

FLYING THE CARAVELLE . . .

290 kt at 13,000ft, thereafter holding it at that figure up to cruising levels. Engine r.p.m. are held at 7,100 up to 30,000ft, then increased slightly (to 7,250) until the desired cruise altitude is attained. Initial rate of climb is about 1,500ft/min (with a jet-pipe temperature of 580 deg C) and service ceiling is in the region of 42,000ft. Spiral stability is positive in both cruising and approach configurations.

In approach and landing configuration the unaccelerated stalling speed at gross weight is about 90 kt, and one finds that a slight tendency to drop a wing can be easily counteracted by use of aileron. At all altitudes, and with any c.g. position, a slight reversal of stick forces occurs at approximately 100 kt. This is not caused by instability, but by airflow changes, and an automatic trimming device now counteracts it, so that the pilot is not aware of the effect. The trimmer is capable of cancelling-out stick forces at any c.g. position and airspeed. Trimming is accomplished by varying the datum position of the jack which applies artificial-feel loads to the control column. The control system [described in detail in *Flight* for May 27, 1955] is fully powered, with two independent hydraulic supplies; there is no means of reversion to manual control.

Asymmetric power produces no yaw, because the thrust lines pass through the c.g., and no trimming is required to counteract yawing or rolling moments. By using the sensitive and effective trimmer it can be established that the Caravelle is longitudinally statically stable in all configurations and c.g. positions.

A standard climb to 33,000ft covers 220 miles, takes 40 min and uses 4,400 lb of kerosine. Between 33,000 and 38,000ft, cruising speed at 7,250 r.p.m. settles at 390 kt with a fuel consumption of 4,400 lb/hr. At 32,000ft, cruising speed is 400 kt and fuel consumption 5,000 lb/hr. Maximum level speed at 20,000ft is 270 kt I.A.S.; and in this condition dynamic stability remains good, even with acceleration from 1.5 to 2 g. Decreased temperatures at the higher altitudes cause a slight control friction, but effectiveness is not lost and the stick continues to return to neutral even after being sharply displaced.

The layout of the air-conditioning and pressurization system was described in detail in *Flight* for May 27, 1955. In practice one finds that the indicators and controls are well positioned and the system as a whole effective. Sea-level cabin pressure can be held up to 18,000ft, which allows the maximum rate of descent of 5,800ft/min to be used without causing discomfort to the passengers. A standard demand-regulator oxygen system is fitted for the crew; and the "blinker" indicators are well placed for easy observation when necessary. Pressurization, air-conditioning, anti-icing and fuel system are controlled from panels distributed around the co-pilot's seat.

The highest Mach number reached during my test was 0.84 at between 35,000 and 40,000ft. The only compressibility effect was a slight buffeting which began at a Mach number of 0.82; and there were no pitching tendencies other than those caused by the normal changes in static stability following increase in speed. Airbrakes, which may be used at maximum Mach number and I.A.S., extend in three seconds but cause a certain amount of vibration. Reduction of power is also an effective way of reducing speed. Aileron effectiveness is maintained at all speeds and Mach numbers.

A typical let-down from 38,000ft to 5,000ft is made without airbrakes at a constant 216 kt in 36 min, covering 150 miles and using 660 lb of fuel. Standard reserves permit 45 min holding at 10,000ft, a missed approach and a diversion of 150 miles, using 6,600 lb of fuel.

During the approach and landing one finds that flap and undercarriage extension cause negligible trim changes, and the airbrakes remain very effective. The normal approach is made with power at $1.5V_{SL}$ (135 kt). Small power-variations produce only small results, but a strongish ground effect in calm conditions distinctly assists the pilot in rounding out. In power-off approaches or strong winds this effect disappears. From the 4,500 r.p.m. approach setting, full power can be reached in five seconds and acceleration is then sufficient to re-establish safety speed very rapidly. With the tail braking parachute the landing run can be limited to 1,800ft; without it, at a weight of 86,000 lb and in standard atmosphere, the ground run is 2,160ft. At 66,000 lb the run is reduced by 650ft.

[A full structural description of the Caravelle, with cutaway drawing, first appeared in *Flight* for May 20, 1955. The electrical, control, fuel and air-conditioning systems were described in the following issue; and later information has been summarized in the issues of July 6, 1956, and November 1 this year.—Ed.]

Tucked closely in to the centre-line, the Caravelle's Rolls-Royce RA.29s minimize the yawing effects of asymmetric power. Nosewheel-steering permits satisfactory ground-manœuvrability.

Constructor and Contributor

Some Thoughts on Accessory Responsibility

A RECURRENT theme in the lecture *Britannia in Service* (summarized in *Flight* last week) given recently by Dr. A. E. Russell, chief engineer of Bristol Aircraft, was the effect upon the aircraft of component unreliability; and in the discussion which followed the reading of the paper, the subject was raised again.

In examining where delays had occurred, and for what reasons, Dr. Russell studied the hours lost in the first six months of operation as a percentage of flying time. The total, he concluded, was "formidable," and the responsibilities for defects could be split amongst "the aircraft manufacturer, engine manufacturer and equipment and accessory supplier in the ratios of 1:3:4 respectively." Diagrams used to illustrate the text showed which components contributed least to system reliability.

Now, apportioning responsibility for failure is a distasteful matter at the best of times, and the breakdown of defects was given in the lecture only so that it could be clearly seen where lay the troubles that had to be overcome. And it is repeated here, not to show up the airframe in a better light or the components in a worse one, but to highlight a gradual but significant change that is taking place in the relationship between the prime contractor and components supplier.

It is an unfulfilled dream of the aircraft manufacturer and the operator's maintenance engineers that it will one day be possible for the former to order, off the components manufacturer's shelves, just the type of equipment that is required. And not only will it exactly meet the application for which it is intended but will have a guaranteed overhaul life of preferably 1,000 hours or more to start with.

But this pleasant vision overlooks the hard economic facts of the components manufacturer's economy, and ignores the very varied equipment that the relatively few firms engaged in the manufacture of specialized equipment within the aircraft industry are called upon to supply. It ignores, too, a realization that is fundamental to all aircraft engineering; the state of the designer's art is never static, and the components supplier is always anxious to offer improved equipment—the production of which is too often, alas, "just around the corner." Determined attempts are made from time to time to make direct use of equipment that is already in service in other aircraft; but only too often the effort is defeated by the necessity for adaptation (a wondrously accumulative process) or for modification as the result of service experience. In practice, it does not necessarily follow that because a piece of equipment has seen long service it is satisfactory in every respect; it may, for example, be difficult to maintain or be quite incapable of handling a further increase in load.

More often than not, then, new aircraft demand new equipment, and in increasing quantities; equipment that takes time to design and longer to develop. The diversity of effort in the component industry may be judged from a random figure quoted by Dr. Russell that one firm employed 1.3 men per item of equipment produced, and suppliers to other industries have not, in the past, always accorded the aircraft industry the development and production effort that the competitive climate of the latter requires. Dependent for business as they are on the choice of the prime contractor, firms within the components industry are not going to allow production-capacity limits to stand in the way of the acceptance of new orders. Suppliers may, in fact, find themselves pressed by the aircraft manufacturer to undertake new work; the industry is not so large that there is invariably a competitor willing to tackle what the rival firm cannot. But the ensuing delays and retarded delivery dates are frustrating to aircraft and component manufacturer alike.

One danger of any detailed component-failure analysis (and in the Britannia the "general run of component reliability appears not very different from the older types of aircraft") is that if the aircraft manufacturer or operator passes on the responsibility for failures to the manufacturer of, say, electric or hydraulic systems, this very relegation of responsibility leaves the way clear for the accessory supplier to follow the same precepts. "As prime contractor" (of a major component or system) the latter may say, "we can show a very high degree of reliability to have been achieved; only the components supplied to us have spoiled an otherwise excellent record." And so *ad infinitum*.

Where does the primary responsibility lie? Clearly, the manufacturer of the aircraft must don the mantle; the aircraft can no longer be regarded as just an airframe, but must be visualized as a complex of structure, equipment, systems and so on. To a considerable and increasing extent, this is being done. The airframe manufacturer apprises the component suppliers of their individual responsibilities as to delivery dates and the overhaul periods required, advises on design limits and co-operates very closely in the development and testing stages. He will encourage the component manufacturer to run an extensive type-test to develop reliability at an early stage and run acceptance tests on components as they are delivered. And he will press for early delivery of rig units so that environmental tests of complete systems can be run before the clamour of the production programme becomes over-insistent.

On the extent to which these processes are followed—and the dictum of prime contractor's responsibility was accepted without qualification by Dr. Russell in discussion of his paper—does the ultimate reliability of the aircraft in service depend. We have previously attempted to show in an article ("Control System Outlook," *Flight* for November 15) how important it is becoming for the component industry to develop long-life equipment in anticipation of the operator's need; equally so is the part both aircraft and component manufacturer must play if systems engineering is not to be the Achilles' heel of the next aircraft generation to go into service.

A.T.P.

U.K. AIR-SURVEY DEVELOPMENTS

THE results of an airborne magnetometer survey of 15,000 sq miles of Southern England were recently delivered to the Geological Survey, South Kensington, by the operating company, Canadian Aero Service, Ltd. This was the second such survey to be carried out in this country by Canadian Aero: as in the first operation two years ago (described in *Flight* of November 4, 1955), the aircraft used was Anson G-AMDA of Derby Aviation.

The purpose of the survey, carried out for the Department of Scientific and Industrial Research, was to study concealed rock structures in the region. The area was traversed by north-south runs at two-kilometre intervals, flown at an altitude of 1,800ft. Overland navigation was by visual means, with the flight-path recorded by a 35mm continuous-strip Aeropath camera; while for the 2,250 sq miles of over-sea flying off the south coast the Decca Navigator system was used.

Derby Aviation's Anson, fitted with a Gulf magnetometer, was based at Croydon, Yeovil and Kidlington during the survey. The final total-intensity maps recording the magnetic data were produced in the exceptionally short time of 2½ months after the completion of flying.

It was announced shortly after the survey that Canadian Aero Service, an Ottawa company, had merged with the Geophysical Prospecting Co., Ltd., of London, to provide an integrated exploration service from the air and on the ground. The U.K. headquarters of the two companies are at 20 Albert Embankment, London, S.E.11, where William DesLaurier, who headed the survey described above, is manager of the Canadian company's London office.

For the oil and mining industries and for the governments concerned with the development of natural resources, Geoprosco and Canadian Aero are equipped to perform airborne geophysical surveys by magnetometer, scintillation counter and electromagnetic detector, and to carry out magnetic, electric, gravimetric, seismatic, and other forms of resources survey. Additional services include Shoran positioning for surveys over jungle, desert and water; airborne profile recording for reconnaissance purposes; and topographic plans for development projects.

"FLIGHT" PHOTOGRAPHS

MANY of the photographs reproduced in Flight, i.e., those taken by our own photographic staff (as indicated on publication) are subsequently available in the form of high-quality prints. Prices are as follows (dimensions given in inches): 5½ × 3½, 1s 4d (glossy or semi-matt, unmounted) or 2s (toned sepia, unmounted); 6 × 4, 2s 6d or 4s; 8 × 6, 3s 6d or 5s 6d; 10 × 8, 5s or 7s 10d; 12 × 10, 6s or 9s 8d; 15 × 12, 9s 6d or 13s; 20 × 16 (semi-matt only), 13s or 18s.

Also available are a postcard series, totalling over 200, depicting both historic and modern aircraft of the R.F.C., R.N.A.S., R.A.F. and Fleet Air Arm. Complete lists of the series are obtainable on application. Prices are 8d each card, or 7½d each for quantities of a dozen or more. One view only—in most cases a good three-quarter front or side—is available for each aircraft type.

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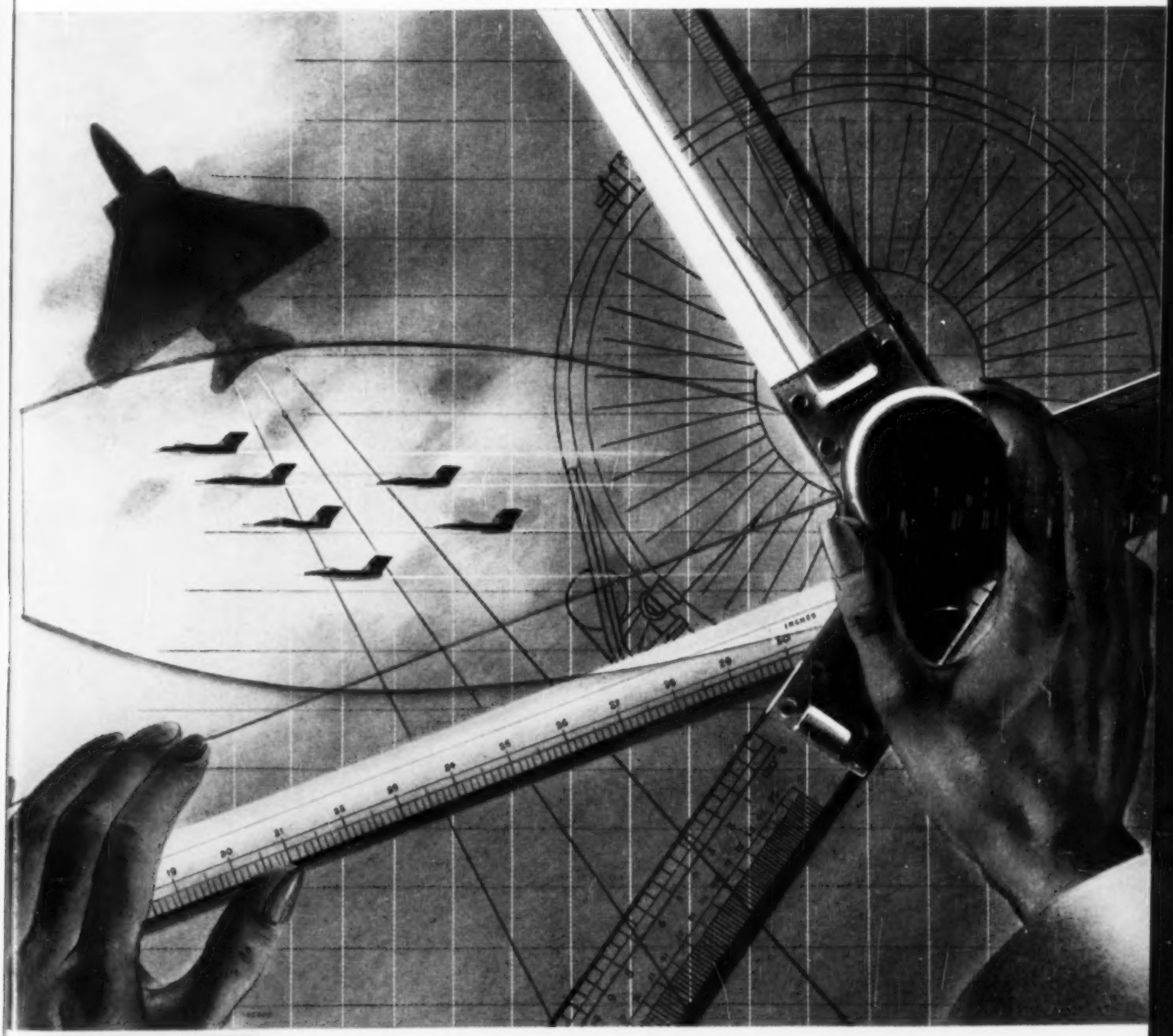

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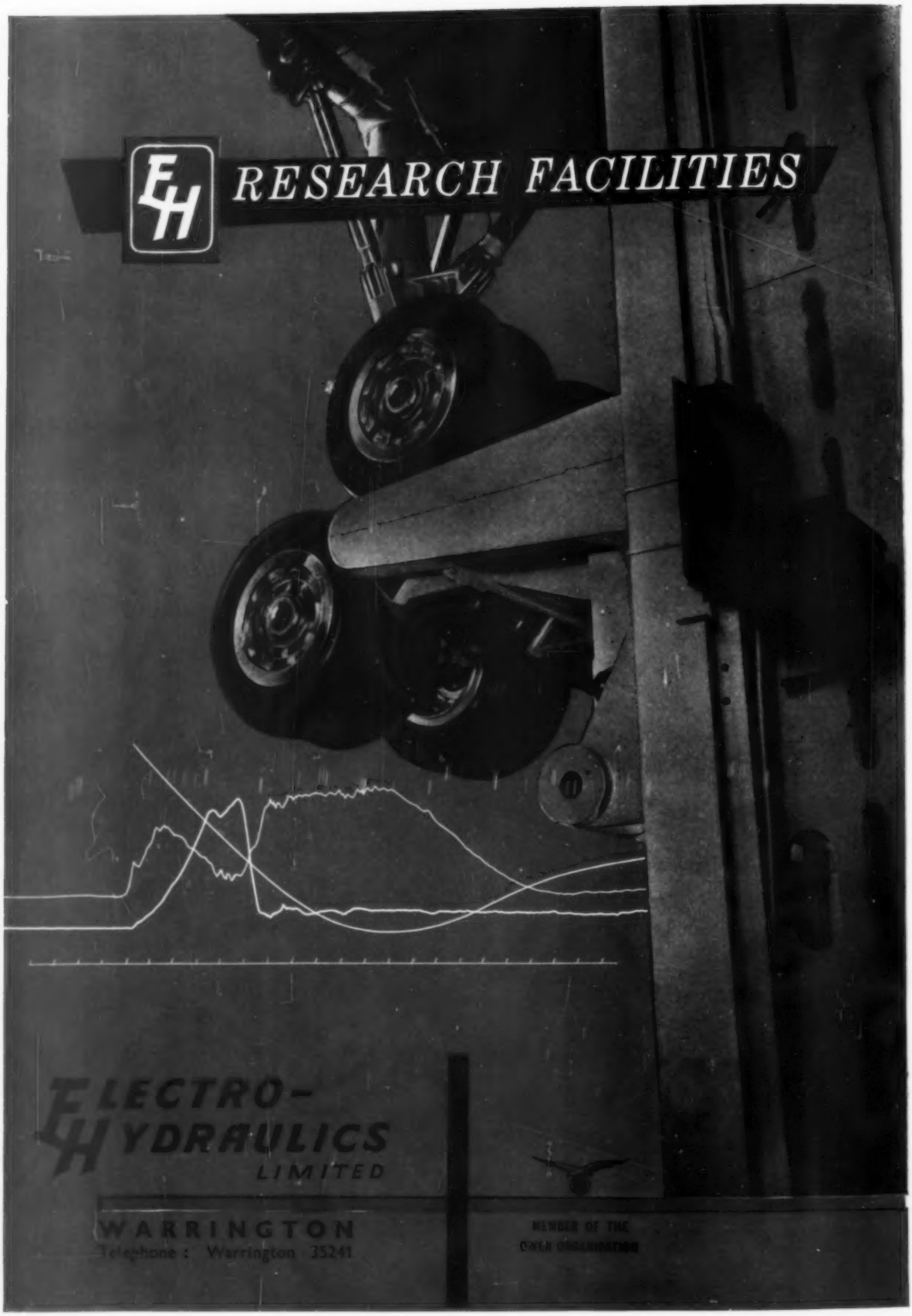
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IT'S NEW, DARING, SEXCITING, SEXATIONAL!

Relax with Flighty

THE AERO-NAUGHTY-CAL WEEKLY

Hey, hey, hey! Meet Flighty's own luscious glamour-gal, a real beauty-cutie—and air-minded, too! Lovely hobbyist Eva Lynd holds up a 57-inch U-control P-61 Black Widow model airplane to prove that all streamlining isn't done on the drafting board. Occasion was recent hobbies exhibition in New York. Note three-bladed props, leading-edge intakes and other important attribeauts.

IN THIS ISSUE:

- **Flight of Passion**
  Torrid Serial Romance of the Airways.
- **Rock 'n' Roll with Flighty**
  We're gonna rock around the Clock tonighty
  With the greatest crazy verses in this week's Flighty.
- **Fashion-Ration**
  You'll see more of air hostesses next year.
- **My Love is like an ICBM**
  Penge Girl's Rocketing Romance.
- **Thundergoof in the Air**
  She handled beautifully, it says here.

Flight of Passion

By ROMA MAÑANA

His head was in the clouds. All he could offer was an airborne affaire. But Jane yearned desperately for the luxury that could never be theirs . . .

THE STORY SO FAR: Jane Lovebounty, attractive radar operatress in the control tower of mighty Blackwick Airport, is in love with Peter de Rigeur, handsome airline captain and ex-wartime fighter ace. Paul Thudge, handsome junior pilot with the same airline, is in love with Jane, but cannot forget Thelma who, he remembers guiltily, is his wife. Paul's wife Thelma, attractive blonde physiotherapist who works at the airport hospital, has been jilted by Peter's twin brother Jason, handsome executive with a birdcage manufacturing company, after they had planned to fly to Majorca to get away from it all. Meanwhile, old Mrs. Trashbile, housekeeper to Paul's attractive sister Rosa, for whom Peter nourishes a secret passion, has discovered the divorce papers which Robert, Paul's father, was concealing from Julia, Thelma's attractive teenage daughter, in the hope that the mortgage on the airport, which his company has illegally acquired, will fall into the hands of Mary, his attractive secretary, who is calling at Sir Ralph's house that evening. Now read on. . . .

IT seemed an age since Peter had flown in to Blackwick Airport. An eternity since he had gaily leapt from the cockpit even before his plane had finished its landing run, with a slap on the back and a merry quip to the Customs man, and had swept her into his arms, saying softly, "Mission completed, honey. Let's go eat at Henri's." They always ate at Henri's. The food was terrible, but then it never seemed to matter when Peter was there, the light of flying still in his eyes and the goggle-marks still etched in his handsome face.

Jane turned from the wide window of the control tower and wiped a tear from her cheek. You never knew where you were with Peter, she thought. Sometimes he gave the impression that flying was all that mattered. "You just don't understand, honey," he used to say, his grey eyes reaching up and out into the never-attained horizon that was his destiny.

Paul was different, of course. And here he was, striding across the runway with that mysterious, serious smile flitting across his enigmatic face. "Good morning, Miss Jones," he would say.

"Good morning, Miss Jones."

"Good morning, Paul."

"How about a trip to Le Touquet, Miss Jones? I have to fly Foxtrot Tango over on a calibration check, and there's a seat for you if you would like to come. We'll be back by teatime."

* * *

And so here she was, having supper with Paul in a hotel in Le Touquet. It was long past teatime, for the calibration check had needed repairing on landing, and they would not get away until the next day. She had not seen her room at the hotel yet, but Paul had smiled reassuringly when she had asked about it. The champagne was delicious.

The flight over had been heavenly. Seated in the co-pilot's seat next to Paul, she had experienced that other-world feeling known only to those who fly—those who soar with the birds through blue sky and white cloud.

"Tired, Jane?" The voice interrupted her thoughts. "Well, I suppose so, Paul," she answered. Had she had a little too much champagne, she wondered? Paul's hand felt somehow comforting on her arm as they left the restaurant.

Two people, a man and a very attractive girl, were signing in at the reception desk as they walked from the restaurant across the lobby. Jane felt her body stiffen and the blood drain from her face as she heard the clerk repeat "Mr. and Mrs. John Smith." and as she saw the man smile down at the girl.

"Peter—you . . ." she choked. "You said you were flying the mails to Buenos Aires this week . . ."

Has Jane discovered Peter's Guilty Secret?

Were Paul's intentions honourable?

Was the calibration check really unserviceable?

Who was the mysterious stranger in room 427?

Do not miss next week's gripping instalment of FLIGHT OF PASSION.

EXCELLENT view, pleasing design and good accessibility are features of this DC-6B cockpit layout. At last they've put what the pilot wants where he wants it, commented ace airline captain.

The heading picture is from the Universal-International film "The Lady Takes a Flier." (Lana Turner and Jeff Chandler.)

♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥ ♥

A.C.2: How do you spot a night bombing target, Sarg?
Sgt.: Oh, we have a flair (flare) for that sort of thing.

* * *

Airline Boss: You've been working here at the stewardess hostel for four weeks now. How come you've not been along to collect your pay?
Night Porter: You mean I get pay, too?

* * *

C.F.I.: That new instructor is impossible. You know, he keeps goats in the clubroom and the smell is terrible.
Student Pilot: Why don't you open the windows?
C.F.I.: What, and let all my pigeons out?

HAS she got the time? Why yes, but its not a wrist-watch on the shapely limb of attractive Pan American stewardess Joan Autry, it's a thigh-pedometer. My, my, what will they think of next?

CLUB ROMANCE DENIED

ATTRACTIVE blonde starlet Lilo La Vie today denied stories linking her name with that of the chief flying instructor of the Denstree Aero Club, handsome J. J. Oglethorpe, ex-R.A.F. fighter ace and pigeon-fancier.

"Jeremy and me are just good friends," she said, just before leaving her Mayfair penthouse for Denstree studios where she is currently filming *Round-Table Rock*, the authentic story of King Arthur and his Solid Squares. In between filming, Lilo is learning to fly at Denstree Aero Club, where she first met the lucky J.J.O.

Interviewed at Denstree, C.F.I. Oglethorpe said, "Miss La Vie is an apt pupil. She is rapidly gaining experience and is very co-operative. We had two hours under the hood yesterday." So the stories were true, I thought to myself.

"Mr. Oglethorpe, is she in love with you?" I asked.

"Miss La Vie stalls very well, and retains excellent control at all parts of the circuit."

"Are you in love with her?" I enquired.

"Well, she needed my assistance in pulling out of a low dive the other evening—"

"—in Soho?" I suggested.

—"at 800ft over Croydon," he continued.

"Are you going steady?" I queried.

"Miss La Vie and I are flying straight and level."

"May we expect romantic developments in the future?" I quizzed.

"Well," his serious face broke into a boyish grin, "as the altimeter said about the doubtful artificial horizon, I shouldn't bank on it—eh, ha, ha?"

"Bank on it—get it, old boy?" repeated Oglethorpe with a short laugh as, whistling gaily and affectionately embracing his next lady pupil, he swung the propeller, extinguished his cigarette in the whirling disc, leapt into his mighty Hawk airplane, roared into the air and looped the loop over the nearby Denstree studios.

TOUJOURS LA PILOTESS. Typical British girl fliers deal with crossed rudder controls (above) and no-hardad flying (below, left). Ah yes, smooth-looking chicks match smooth-flying airplanes for sure, whatever that may mean.

SUPERSONIC TOPIC

Flighty-Testy Report on the Thundergoof

BY MACH LAMBERT

AT the controls of Britain's latest superjet, the Crystal Thundergoof, today I challenged the thermal thicket to bring Flighty readers the real low-down on the unsolved problems of supersonic flight. How did the mighty jetplane fly? She handled beautifully, needless to say.

Ground-handling was perfect. Visibility could hardly be improved—by standing on top of the cockpit coaming I could almost see the ground. I found that, by moving the throttle forward and increasing power, the airplane's speed increased.

One of the exceptional aspects of flying the Thundergoof was that, to gain height, I simply pulled back on the stick. What was more, when I moved the stick forward we went into a dive!

Going through the sound barrier was child's play. In fact my parachute worked perfectly and I was able to take off again in the second prototype after only a few hours. As for the thermal thicket, certainly the airplane warmed up a little, but the sudden immersion into the North Sea soon cooled us down and I was able to take off again in the third prototype early the next day.

Summing up, I would say the Thundergoof really is tops. In fact, she handled just as perfectly as in the company test pilot's initial report (circulated to the Press by the company's publicity department some six weeks before the maiden flight).

1st Pilot: I wonder why old George wears a Cellophane shirt?
2nd Pilot: Oh, the doctor told him to watch his stomach.

* * *

1st Stewardess: Do you like my new uniform? It's 200 per cent pure wool.
2nd Stewardess: 200 per cent pure wool? How so?
1st Stewardess: The sheep led a double life.

My Love is Like an ICBM

"He's Just the Ultimate"—Penge Airgirl

by Flighty staff reporter

CUPID'S DART, shot with the exuberant ferocity of a ten-stage rocket, landed today with a soft "Aaaah" in the heart of Julia Ooperdu, attractive 18-year-old blonde from Lower Penge, Surrey. Object of her affections? A shy young scientist at a top-secret Rocket Research Base in the heart of rural Dorsetshire.

"It all began on Flight 362 from London to Birmingham," Julia told me today. "I was the stewardess and Aegon — that's his name—was a passenger. He was going to some top-secret conference thing on missiles and I had to fasten his seat-belt for him, he was so nervous. He even refused a barley sugar."

"Love at first sight?" I asked. "Well, yes and no," Julie answered. "Six weeks after the flight, I was sitting at home watching the telly, and there was a knock at the door. It was Aegon." "Did he sweep you into his arms in a wave of uncontrollable passion and declare his undying love?" I asked. "Oh no," she smiled coyly. "He said he'd changed his mind, he would like a barley sugar after all."

★★★★★★★★★★★★★★★★

Fashion Ration

BY CONSTANT BIND

Airgirl fashions for 1958, I can reveal, will highlight brevity plus style. The new-style fashions themselves reveal plenty of imagination. Comment of seasoned air-travellers when offered barley sugar by the smooth-clad cuties will most likely be a dazzled "Help!"

Foto shows lines now under development. The frozen North won't stay frozen any more, for sure, when these glamour-gals from S.A.S. take a hand on the Polar route. At left, the old-hat uniforms of 1957. At right, the up-to-the-minute beauty-suits of 1958. Notice any difference, men? Well, the cap-badge is the same.

★★★★★★★★★★★★★★★★

AIRFILM EPIC

NOW SHOWING at your local cinemas is *I Was a Teenage Air Marshal*, starring Timmy Stoole, Marmol Brandsatch and Jean Maynsfold. Dedicated to the men and women of the Loyal Welsh Air Force, this epic picture has original theme music specially written for it by Eric Doates with the title *Reach for the Knightsbridge-Busters March*. You will enjoy this music, as you have enjoyed it so many times in the past. You will probably like the film itself, too.

It tells the story of a flight cadet (Timmy Stoole) in the Loyal Welsh Air Force who disconcerts Authority by his unconventional arrival to begin training at Llanwell. It follows his Forces career—he is the only L.W.A.F. pilot not to belong to an aerobatic team; he does not abduct his squadron commander's wife; he does not harbour a grudge and become all mixed-up; and he is not brought in without oxygen from a dizzy height by his worst enemy. A strikingly unusual career, you will agree.

Eventually he forecasts "fatigue" in the framework of a transatlantic airliner, but not before he has tried his hand at racing a plane around pylons ("That Coventry air just does something to a chap, eh, Smithers?") and has made two trips to the Moon and one to Mars.

Love interest is supplied in breathtakingly generous proportions by the girl next door (Jean Maynsfold), who is married to a drunken, penniless aviation journalist (Marmol Brandsatch) who finally commits suicide to make possible a happy ending for his wife and the Air Marshal.

From Bad to Verse . . .

ODE TO MISS JONES, AERODYNAMICS DEPARTMENT

Aerodynamiciste, say you'll be mine
For many a year we've been drawing the line
And now I must say it and I'm no line shooter
But you seem more fond of that ruddy computer.

Or, aerodynamicistress, should I say?
Won't you leave your slide ruling and come out to play?
I love you, I love you, I've nothing to hide
Enough of slide-ruling—let's just start to slide.

I know that you're fond of your basic research
But that's no excuse when I'm left in the learch
I'll stand it no more, no, not even for science—
Come, let us establish a secret alliance.

Please show me a sign that is different from formerly
A symbol which indicates I'm in your formulae
Please say of my presence at least you're aware
We can't think forever of half-rho-vee-square.

So why not forget all your airstream velocities,
Windtunnel balances, other monstrocities
And try a new tunnel, the tunnel of love
Of which such a lot I've been telling you of.

Diffuser, contraction, and main working-section,
All round the circuit you've blown my affection
And please don't just sit there and contemplate space
It's urgent, I want you, there's no time to wace.

Now why not get rid of that force-balance frame
To wherever from whence the darn thing came
Let's flee the establishment, fly by night
For aerodynamics, read Gunston in Flight.

So please, Mistress Jones, won't you give me a chance
And experiment on this thing called romance?
Forget about figures and data and stuff
I warn you, Miss Jones, that I've had quite enough.

FOTOCOMP

Final Selection of Mixed Pix

ORIGINALITY was the keynote in our Flighty Fotografic Kontest. Here are the four finalists. Note creative imagination, absence of ordinary, artificial poses and old familiar clichés.

FIRST PRIZE goes to pic above. This shows Dave Bump of Syracuse, N.Y., a flying fumigator in Girardot, Colombia, checking his next crop-dusting job with a local hacienda owner. Bump, who's been spraying farm areas in the hazardous mountain areas for the past four years, is the idol of the farmers in the area because of his war against weeds and bugs.

☛ Technically, this pic is tops. Note angle of hacienda owner's foot on wheel of plane. This stamps pic rightaway as above-average. Note also presence of plane—a thoughtful idea in composition for, if plane had been omitted, hacienda owner's foot would be approximately 18 inches off the ground.

Win Yourself London Airport

Great New Flighty Competition

Readers, have you ever wanted six square miles of runways, taxi-strips, buildings, underground tunnels, concrete aprons, car parks and miscellaneous aircraft, with which to do with exactly as you like with? Of course you have. In case you're tempted but not quite sure, it includes ROOF-GARDENS! CONTROL TOWER! TWO WHOLE ENGINEERING BASES! AND YOUR OWN TELEPHONE EXCHANGE! Now you're sure, for sure.

And now you're sure, you're sure to want to enter Flighty's Great New Contest, which starts next week.

IT'S EASY! IT'S SIMPLE! IT'S FUN!

Read next week's issue for full details, and remember:

First prize—London Airport.
Second prize—An Air Chief Marshal.
Third prize—The Air Ministry.

PLUS 50 consolation prizes of redundant chief designers.

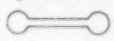
IT'S AMAZING! IT'S NEW! IT'S A SCREAM!

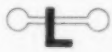
Order your copy NOW.

Intriguing new undercarriage designs planned for Farnborough Show, 1958.

COME CROSS-COUNTRY!

WHAT better way of spending a weekend? Hop in the old plane, take off and head for pastures new. Just in case you can't reach the pasture and are forced to make an emergency landing at an aerodrome on the way, however, be sure you know the regulation ground signals:


The C.F.I. is a weightlifter.


The C.F.I. is learning to be a weightlifter.

T *It is 4.30 p.m.*

Our runway has a right-angle bend in the middle.

C *Flying suspended—croquet in progress.*

H *The clubhouse is equipped with television.*

. . . From Verse to Worse

I wanna write for Flighty
The mag that's got it all
I wanna write with elegance
—Excuse my vulgar scrawl.

I wanna write for Flighty,
To follow able editors
I wanna see my name in print
And learn to dodge my creditors.

I wanna write for Flighty
On how this airplane flies
"She handled beautifully"—but
I now hospitalise.

I wanna write for Flighty
Those technical descriptions
And even maybe read the things
—One of the worst afflictions.

I wanna write for Flighty
—What's even more absurder
I realise, to many eyes,
They get away with murder.

I wanna write for Flighty
The news of industry
Those tax-evading dodges
Unknown to you and me.

I wanna write for Flighty
But one thing seems to vex
The mag has wit and sparkle
—But you mustn't mention jet engines

I wanna fly with Flighty
I wanna be a bird
I wanna be a pilot-man
—Don't tell me that's absurd.

I wanna fly with Flighty
I gotta read that mag
I oughta know 'bout flyin'
—Don't tell me it's a gag.

I wanna fly with Flighty
You wanna know just why?
Because I need the money, mac,
That's why.

VICTORS

HARD-HITTING ATTACKS

SIR FRANCIS DRAKE, renowned for his hard-hitting attacks on the Armada, won notable victories in Elizabethan times. The first Briton to circle the globe, he ranged far into unknown and distant seas in his tiny ship.

Today attacks harder-hitting and farther-ranging than Drake could have conceived lie in the power of the . . .

VICTOR—BRITAIN'S PREMIER STRATEGIC BOMBER

HANDLEY PAGE RADLETT LONDON READING

951
FLIGHT,
20 Dec.
1957

TELEVISION INSTRUMENTS

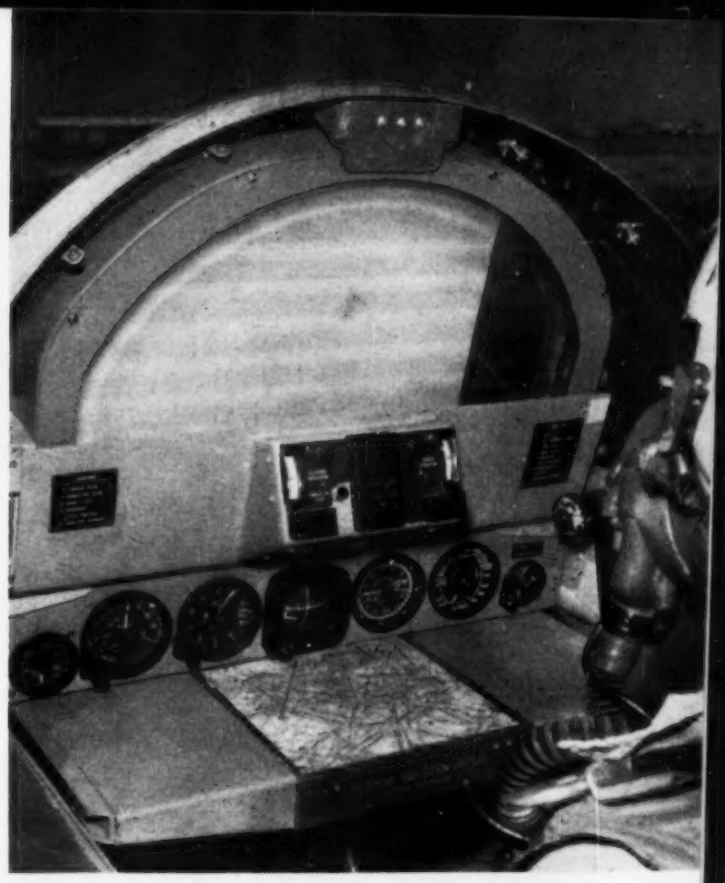
A New Panel for Civil and Military Aircraft

THE results of a joint U.S. Navy and Army programme of blind-flying instrumentation for both fixed-wing and rotary-winged aircraft have now been presented to the American civil airlines; and flight tests in a Lockheed T2V SeaStar are well under way. Called ANIP (Army-Navy instrumentation programme), the new system displays attitude information to the pilot by projecting a grid lattice in perspective on a flat, transparent television tube set up between the pilot and the windscreen. The flat tube is called a contact analogue; and a "contact analogue generator" controls the positioning of the grid in attitude and perspective so that it accurately represents the position of a theoretically flat Earth in relation to the aircraft.

The TV tube, made by Kaiser Aircraft and Electronics Corporation, is 2¾in thick and transparent, and may also be put into production for wall-mounted domestic TV sets. A powdered-glass solder is being used to seal the vacuum space in the screen, electrode elements being printed on the inside surfaces. Roll, pitch, yaw, attitude and translation in two directions relative to the Earth are measured and applied to the grid picture at a rate rapid enough to be well beyond the flicker threshold of the observer. Allen B. Du Mont Laboratories Inc. make the contact analogue generator.

In addition to presenting this realistic grid picture of aircraft attitude and movement the new instrumentation system navigates for the pilot. A digital computer shows the pilot true airspeed, Mach number, height, and rate of climb; it also makes cruise-control computations from assessments of weight, fuel, time and distance. It will tell him distance and time to destination, predict fuel consumption and calculate the best height and speed at which to cruise, taking into account any climb and descent involved.

Made by Litton Industries, the digital computer weighs less than 40 lb and can make 15,000 computations per second. Thirty times per second it calculates the location of the aircraft and adjusts the distance and time to go indications. Design of this computer began two years ago and more advanced versions are now contemplated. It seems likely from the information so far released that Doppler or inertial navigation inputs and signals from an air-data computer and a master-gyro platform can be or are being used. The Litton computer has a magnetic-drum memory capable of storing 100,000 "bits" of information on a surface of 25 sq in.



To allow for the effect of environmental conditions the magnetic head rides over the drum surface on a flexible mounting; and time sharing of portions of the transistorized circuitry provide considerable saving in components. Analogue-to-digital conversion devices and special methods of coding information have also been developed. Altogether some 600 companies are involved in ANIP.

The accompanying illustrations show the first installation which has been flown in the front cockpit of a T2V for the past three months. The television presentation is so simple that an engineer without pilot experience was able to fly the aircraft successfully for a considerable time. Fixed-wing application for the U.S. Navy is under the control of Douglas El Segundo, who hold the co-ordinating contract. A great deal of evolution still remains to be done, but Douglas hope to supply the system for use in service in two or three years' time.

A similar co-ordinating contract on behalf of the U.S. Army, designed for helicopter application, is held by the Bell Helicopter Corporation. Douglas gave Bell all the accumulated data on the

Illustrated, above right, is the first airborne installation of the new U.S. Navy/Army instrument system, in the front cockpit of a Lockheed T2V SeaStar. The rear cockpit of the same aircraft, above left, is laid out in the traditional manner. An altogether futuristic layout, right, is destined for aircraft built from the start for the system. Both the SeaStar and the mock-up show the flat, transparent television tube in which a grid pattern in perspective is presented and orientated continually to indicate the attitude and movement of the aircraft relative to the Earth. Stand-by instruments are located beneath and a roller-map or television navigation display give navigation instructions. The control column in the mock-up, right, is a miniature unit located to the right of the desk-type panel.

TELEVISION INSTRUMENTS . . .

system and Bell constructed a special visual flight simulator using contact analogues and the TV-projected navigation presentation contemplated for the Douglas cockpit. A complete analogue generator installation is being prepared by Du Mont for a U.S. Navy Bell HTL-7 helicopter to be flown early next year. The simulator cockpit is at present stationary, but is shortly to be mounted on a moving platform capable of reproducing pitch, roll, yaw and limited vertical travel. This portion is being made by the Franklin Institute of Philadelphia.

When ANIP was presented to the airlines at a symposium last month considerable interest was aroused, but it was stated that a good deal of development remained to be done and that extensive operational testing would be required before the system could be accepted for general airline use.

NEW ITALIAN AIRCRAFT

THREE new Italian aircraft have emerged in past weeks. The Macchi MB.326 Viper-powered trainer, illustrated below, has been completed and is soon to make its first flight; the de Bernardi Aeroscooter two-seater has been demonstrated in public at Rome; and the Aviamilano Nibbio is almost ready.

Col. Mario de Bernardi is well known internationally for his flying achievements between the World Wars. Since then he has turned to designing and produced the diminutive Aeroscooter (described in *Flight* for January 11), a single-seater, low-wing monoplane on which he mounted a two-bladed rotor for flight as an autogyro. This machine has been flying for some time, but a two-seater was almost inevitable, and this is the machine demonstrated recently. A picture appeared in *Flight* last week.

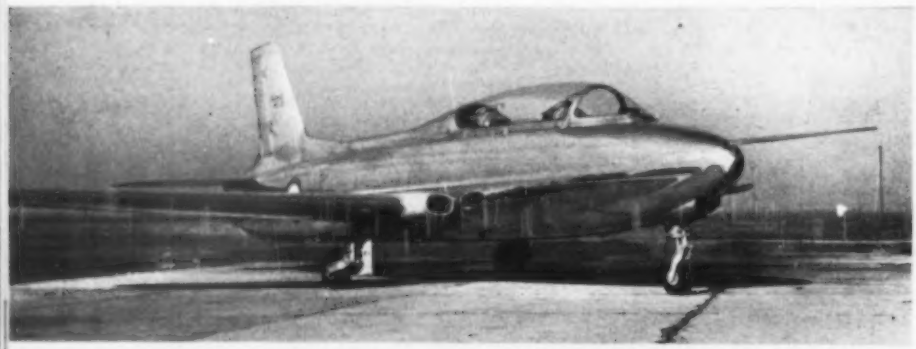
The name aptly describes the function of the aircraft. Powered by a Praga 72 h.p. engine, it has a cantilever, single-piece wing of wood, a forward fuselage of tube steel and a single-piece sheet-metal monocoque tail cone fitted with strutted metal control surfaces. With a fuel load of just over 10 gal, contained in small tanks fore and aft of the cockpit, it has a three-hour endurance. The wooden wing has a semi-laminar aerofoil based on a single spar with leading-edge torsion box and ribs spaced 8in apart. The canopy is a single unit, including the windscreen, which opens by moving forward across the engine cowling. Plain flaps are fitted and the nosewheel undercarriage is fixed.

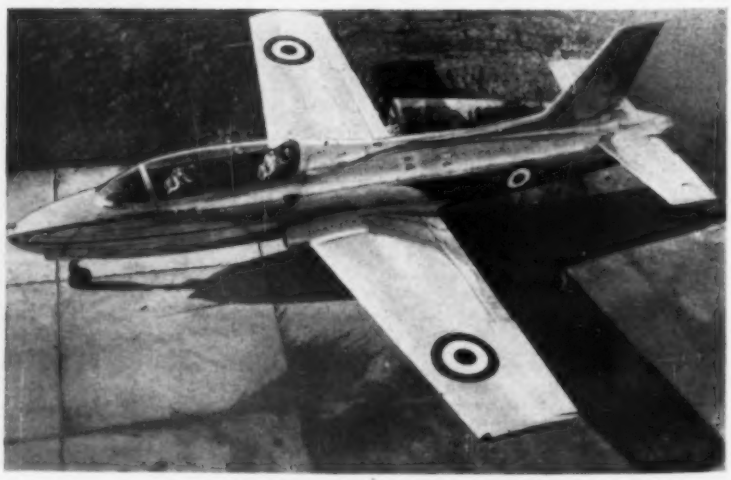
Leading data are:—span, 29ft; length, 15ft 3in; empty weight, 595 lb; gross weight, not including tip tanks, 1,030 lb; range, 350 miles; top speed, 134 m.p.h.; cruising speed, 118 m.p.h.; minimum speed, 31 m.p.h.; landing run, 50 yd; initial rate of climb, 1,380ft; and fuel consumption, 3.4 gal/hr.

Aviamilano, already famous for their two-seat sports aircraft, the F8L Falco, are now producing the four-seater F.14 Nibbio which is a direct extrapolation of it. It retains the same aerofoil sections, wing loading and power/weight ratios of the smaller aircraft, but is powered by the Lycoming 0-360 engine of 180 h.p. driving a Hartzell constant-speed propeller. The airframe is entirely wooden, with plywood skinning, covered with fabric and treated with some 16 coats of paint which produce an excellent finish. Protective coatings and the use of damp-proof synthetic glues are claimed to make the Nibbio entirely climate-proof. The wing has a laminar profile of N.A.C.A. 64000 series with a thickness chord ratio decreasing from 13 to 10 per cent and a wash-out of four degrees at the tip. It has a single-piece, single-spar structure with false spars carrying undercarriage and aileron attachments. All three undercarriage legs are completely retractable by electric or manual means; and full blind-flying instrumentation is fitted as standard. Radio compass and V.H.F. communications radio are also offered.

Hydraulic disc brakes are fitted to the mainwheels and the nosewheel is linked with the rudder bar for steering on the ground. Two 18 gallon bag tanks, one outboard of each main undercarriage unit, carry fuel for a 620 mile range. Full night-flying lighting and an undercarriage-warning horn are standard.

Leading data are:—span, 31ft 2in; 23ft 10in; power loading, 13.4 lb/h.p.; empty weight, 1,425 lb; gross weight, 2,420 lb; baggage allowance, with four passengers and full tanks, 77 lb; maximum sea-level speed, 194 m.p.h.; cruising speed at 6,000ft, 181 m.p.h.; take-off run, 590ft; climb to 6,600ft, eight minutes; service ceiling, 17,700ft.





ITALY'S MACCHI 326 FROM THREE ASPECTS

First open-air pictures of the new Italian jet basic trainer, the Macchi MB.326. It is powered by an Armstrong Siddeley Viper, carries pupil and instructor in tandem in Martin-Baker lightweight ejection seats and can carry gun, rocket and bomb armament for weapon training. The first flight is expected in the near future.

FAIREY | **ROTODYNE**

World's First Vertical Take-Off Airliner

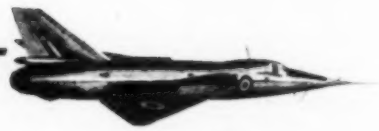
48 Passengers · 185 m.p.h. Cruising Speed

400 Miles Maximum Range

THE FAIREY AVIATION COMPANY LIMITED · HAYES · MIDDLESEX

ENGLAND · AUSTRALIA · CANADA

1956 FAIREY FLEW FASTEST



★ 1957 - Fairey Flies the First

Adding achievement to achievement, Fairey Aviation, holders for almost two years of the World Absolute Speed Record, have now built—and flown—potentially the most important transport aeroplane in the world, the Fairey Rotodyne.

Carrying 48 passengers or 4½ tons of freight it takes off vertically as a helicopter and having gained height flies forward as a normal twin-engine airliner.

It is the most adaptable rotary-wing aircraft in the world and the first to offer operating economy directly comparable to that of fixed-wing aircraft over ranges of up to 400 miles.

The arrangement within the Rotodyne's capacious fuselage can readily be adapted to suit civil or military application.

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Vertical Take-off Airliner

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Powered by two Napier Eland propeller-turbines with Fairey Pressure-Jets at the rotor-tips for take-off and landing.

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FAIREY ROTODYNE

ENGLAND · AUSTRALIA · CANADA

A Merry Christmas
DE HAVILLAND

Rotodyne Report

DEVELOPMENT ASPECTS AND COMMERCIAL APPLICATIONS OF FAIREY'S VTOL TRANSPORT

I—MARKET PROSPECTS

FEATURE articles in this eight-page section of *Flight* deal with particular aspects of the development of the Fairey Rotodyne. On these first two pages we print an interview with G. S. Hislop, Ph.D., B.Sc., A.R.T.C., M.I.Mech.E., A.F.R.Ae.S., deputy chief engineer and chief designer (rotating wing) of the Fairey Aviation Company, on the subject of Rotodyne markets and future applications.

Dr. Hislop, did the Rotodyne concept originate from a particular market survey? If so, what were the main requirements specified by potential operators?

The Rotodyne evolved in its present form as a result of a specification for a large transport helicopter issued by B.E.A. in 1951. Prior to that the Rotodyne, whilst still a transport aircraft, was rather smaller and slower, and naturally (at that stage in its evolution) not much thought had been given to some of the operational problems involved in civil transport machines.

The main requirements were expressed in terms of a minimum cruising speed of 130 knots, a passenger-carrying capacity of 30-40 seats, and a direct operating cost of 3d per seat-mile. This was based on studies carried out by a number of actual and potential operators, but in particular from a fairly detailed analysis by B.E.A. in broad terms of the possibilities awaiting short-range air transport with a vehicle affording vertical take-off and landing capabilities. Sufficient data were available on the overall traffic pattern in the European area, and in the share carried by aircraft and other means of transport over short distances, to indicate clearly the inherent possibilities of the helicopter. A parallel survey of the potentialities within the U.K. was also conducted by B.E.A. to give some idea of the relative weight of traffic to be expected between major cities.

Dr. G. S. Hislop.

What is the Rotodyne's optimum stage length? How much operational flexibility is built into the design?

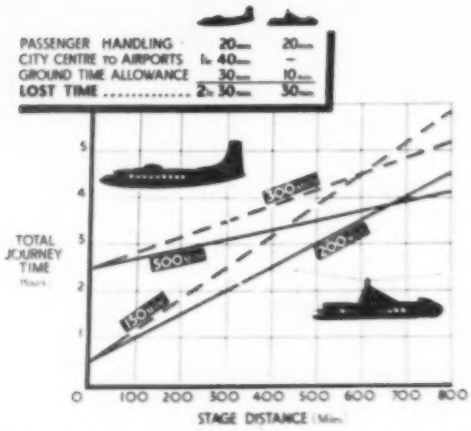
The aircraft was laid out to exploit the heavy potential of short haul between such city centres as London/Brussels, London/Paris, etc., which demand an operating stage-length of approximately 200-230 nautical miles. The main emphasis was directed to achieving optimum economy around this range bracket. However, sufficient volumetric capacity and fuel tankage are supplied to make the aircraft attractive not only over much shorter ranges, but also at ranges up to approximately 350 nautical miles. In addition, of course, by virtue of its wide rear-loading doors and the large door forward in the fuselage, great flexibility is offered in the type of load being carried, i.e., passengers, freight, motor cars, or mixtures of all three.

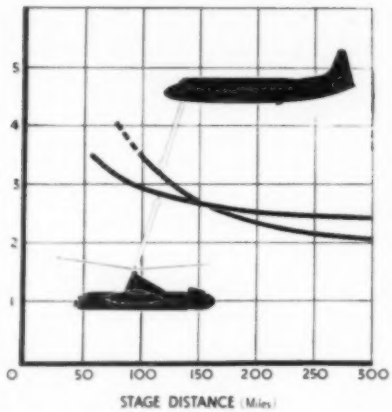
I could perhaps point out here that the layout of the configuration is such that it is possible for the fuselage design to be changed with relatively little disturbance of the powerplant, control and rotor systems. This is achieved because the wing which carries the engines and on which the pylon is built is a one-piece item and is fastened to the fuselage by four bolts. Apart from the controls running from the pilot's cabin to the engines, rotor head, and tail, there is no part of the powerplant or control system in the fuselage itself. This feature has been exploited in the design of the second prototype which is 2ft deeper and some 6ft longer, and still retains the same wing, pylon, and rotor system.

Will the main applications of the machine be civil or military?

In our approach to this aircraft, as the natural result of the B.E.A. interest, the preparation of the basic requirements and our thinking have been directed towards the civil market, and the requirements of a civil transport machine have dominated our approach in many respects. For example, great emphasis has been laid on meeting the one-engine-failed performance requirement, and a great deal of thought has gone into the handling and control problems in this case. This approach has perhaps tended to lengthen our task in designing and building the prototype, since for a purely research aircraft it would have been possible to have omitted certain of these design features. In my view this approach would have been quite wrong, as by-passing fundamental handling, control and performance requirements at this stage would have resulted in having to do a great deal of the work again—and with greater difficulty—when the success of the aircraft as a bare research flying machine had been demonstrated.

We have had firmly fixed in mind that our ultimate objective was to sell the aircraft in the civil market and we have done our level best to meet and anticipate the sort of requirements which will be needed not only by the operators but by the certification


PASSENGER HANDLING 20min 20min
CITY CENTRE TO AIRPORTS 40min –
GROUND TIME ALLOWANCE 30min 10min
LOST TIME 1hr 30min 30min
TOTAL JOURNEY TIME (Hours)
300 m.p.h.
500 m.p.h.
150 m.p.h.
0 100 200 300 400 500 600 700 800
STAGE DISTANCE (Miles)



The Rotodyne's estimated performance (graphs by makers) indicates its time-saving on journeys of up to 400 miles; and passenger-mile operating costs comparable to those of fixed-wing aircraft.

Rotodyne Report . . .

authorities. Enough has been said so far to make it obvious that the machine was designed for, and in fact more than meets, the B.E.A. specification for an inter-city helicopter.

Whilst the aircraft is obviously just as suitable for the transport of soldiers or their equipment as for the carrying of fare-paying passengers, the military asked that the fuselage of the second aircraft be made of a cross-section suitable to carry Army vehicles. This, and possible interest for car-ferry work, resulted in the second machine being designed with a larger fuselage, as already mentioned.

What interest has been shown by civil operators and military Services in the Rotodyne to date?

A very great deal of interest has been shown in the aircraft by civil operators, and some operators have followed the design and construction very closely and have seen the aircraft at fairly frequent intervals from its inception.

Since the first flight we have had overwhelming evidence of tremendous world-wide interest from all sorts of potential operators. Not only is the civil inter-city type of operator keenly interested, but also those who are concerned with providing air transport in undeveloped territories where the cost of building aerodromes, roads, or railways would be prohibitive. For this type of operator we could fill a real need and we hope that their interest will be shown in the fairly near future in a very firm fashion.

The American Army, in the shape of its Transportation Command, has always shown the greatest interest in the aircraft, and we have furnished performance data and brochures to keep them fully in the picture. Furthermore, we have shown the aircraft in its manufacturing stages to various high-level U.S. Army officers. There is a great deal of interest in the New World on the civil side, both in the U.S. and Canada, and we are in the very closest of touch with the interested major helicopter operators in most countries. In this connection one need only refer to the remarks made by Mr. Robert L. Cummings, President of New York Airways, on the occasion of the opening of the Manhattan heliport:—

"In England today there is an aircraft well advanced in construction which will fly some time next year. It is called the Fairey Rotodyne and gives very real promise of being able to perform the operation we need."

What is the estimated selling price of the Rotodyne? What would be the delivery date for Rotodynes ordered now?

The company is in the process of arriving at a fixed, firm figure for discussion with customers and potential customers, and before this is completed I should prefer not to anticipate the result—which must, of course, depend on whether we plan for 50, 100, or 500 aircraft. If Rotodynes were ordered by the end of this year, we would hope to see them entering service towards the end of 1960 or early 1961.

How does the operating cost of the Rotodyne compare with that of current short-haul transport aeroplanes? What utilization figures are envisaged for the machine?

The operating cost of the Rotodyne, which is approximately 3d per seat-n.m. at the optimum stage distances, is very much "in the same parish" as a short-haul fixed-wing aircraft at the same stage distances; in fact at slightly shorter distances we believe the Rotodyne shows up slightly better.

Since current helicopters run at a cost perhaps five times as much, it is clear that the Rotodyne does bring the rotary-wing aircraft, with all its wonderful possibilities, right into the same economic bracket as a fixed-wing machine and should, therefore, have a similar fare structure. Added to that there is a twin saving in time and convenience of the inter-city operation. These costs are based on the latest S.B.A.C. methods as adapted by the S.B.A.C. Committee for Helicopters, and the utilization assumed is 2,500 hours a year. Since Sabena are already operating S.55s in daylight contact operations at rates approaching 2,000 hours per year, it is quite clear that a fully equipped all-weather aircraft such as the Rotodyne should be able to reach 2,500 hours per year without difficulty, once experience had been gained by the operator.

Is not the noise problem a serious disadvantage in city-centre operation? What particular sites do you suggest the Rotodyne might use in or around London?

The problem of noise in city-centre operations is obviously serious and one which has to be faced by anybody wishing to bring a new and powerful vehicle into the heart of cities.

In this matter of assessing acceptable noise levels, there is obviously tremendous scope for individual feeling and individual ideas, but we have been guided by B.E.A. views and experience as to what would represent an acceptable level; this may be of the order of 95 db at 200ft. The M.T.C.A., who as far as London is concerned are likely to be the arbiters, have not so far committed themselves on any particular figure, though we would believe it would be roughly of this same order.

All large and powerful helicopters of inter-city transport type will have to have some means of reducing the noise from their powerplants and rotating systems to this level. In the case of the Rotodyne, our experience so far would suggest that the problem of reducing the noise of the rotor, though difficult, is not impossible, and I think that it can be claimed quite fairly that those people who have heard the aircraft flying in its present raw and unsilenced state, have been pleasantly surprised. We do not pretend that it is quiet, but we consider that the character of the noise and the intensity are such that applying the silencers, on which we are working very hard and which have given good success so far, does give us a real chance of bringing the noise down to an acceptable level.

In this matter I feel very strongly that the manufacturer, the operator and those responsible for heliport design have each got their bit to contribute if inter-city helicopter operations are to become an accomplished fact. The manufacturer must make his contribution towards silencing the vehicle, the operator must make his contribution by take-off and landing procedures which minimize the nuisance to those living in the vicinity of the heliport, and the building authorities must design the heliport and choose its site so that as far as possible the extra noise due to helicopters does not greatly increase the general noise in the vicinity. My own personal feeling on this is that a heliport should be sited in the vicinity of a railway station, if not actually built upon the roof (which would be in many cases an ideal solution). Not only is the noise level there generally fairly high, but it is also a focal point of surface communications.

I am not a great believer in the value of surface sites in cities for really large helicopters where the traffic is heavy, because the clearance of the site and the maintaining of the necessary safety approach angles are likely to make such a site prohibitively expensive.

If the roof of a railway station cannot be employed (and here Waterloo, I think, would be nearly ideal, since the station itself is raised fairly high above local street level), I would personally favour a large building with a roof of the requisite size—recommended by I.A.T.A. as 400ft × 200ft. The major bulk of the building can be devoted to car parking or a multi-storey garage and thus help to fill one of the pressing needs of all the major cities nowadays. At the same time, such a design of garage obviously raises fuel-storage and fire-risk problems which would be present in any heliport, so a building devoted to both purposes simultaneously seems to offer many advantages. The upper two or three storeys would be adequate for all heliport work, and revenue earning therefore would be possible from the bulk of the building throughout the year.

Have you any other comment on Rotodyne applications?

I believe that the flexibility of the Rotodyne with its large and capacious fuselage and rear loading doors makes it an ideal short-range air transport suitable for passengers, for goods and for military vehicles all the world over. Its good single-engine performance will enable it to deal with all-weather operations, flying over jungle or other difficult terrain. On balance I feel that once the aircraft is established there will be just as many, if not more, users of the aircraft in rôles other than inter-city transport.

ROTODYNE REPORT . . .

2—BACKGROUND TO DEVELOPMENT

SINCE its beginning in 1947, helicopter development by the Fairey Aviation Company has followed two main directions. The first of these led to the Gyrodyne configuration (single rotor for vertical flight, propeller for anti-torque and forward flight) and the second to high-pressure jet propulsion of the rotor blades. It is the logical combination of these two concepts that has produced the unique transport aircraft that is the Rotodyne.

Powered by a single Alvis Leonides engine, the Gyrodyne first flew in December 1947. Two machines of this type were built, the first of which, flown by Basil Arkell, established a speed record for helicopters of 124 m.p.h. in June 1948. Meanwhile, research into the jet propulsion of rotor blades had been started and design studies for 20-passenger helicopters were being put forward.

Also projected were designs for an even larger aircraft, a 40-seater which would incorporate a single five-bladed rotor with tip-jet units. Various powerplants were considered for this machine, for which the name Rotodyne was selected. Three bled Rolls-Royce Darts formed one possible installation; others comprised various combinations of Darts and de Havilland units. One project, illustrated below, featured two de Havilland H.7 gas turbines, mounted on the rotor pylon and driving auxiliary compressors which were coupled to two wing-mounted propeller-driving free turbines.

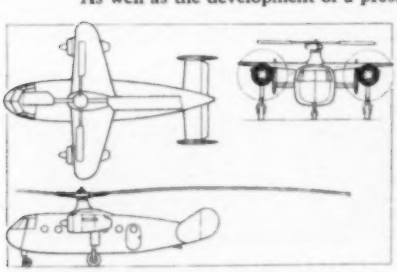
It was the B.E.A. specification of December 1951 which provided confirmation of the need for such a machine and added impetus for the Rotodyne project. Fairey's proposal to meet the 30-40 passenger "Bealine Bus" specification again incorporated the projected de Havilland H.7 powerplants. They were to be mounted in two underwing nacelles, in each of which was located a main gas turbine driving an auxiliary compressor and (mounted in tandem) a further gas turbine driving a constant-speed propeller through a reduction gear. Air for the propeller turbine was tapped from the main engine's auxiliary compressor; tractor and pusher configurations were suggested as alternatives. The rotor was four-bladed with pressure-jet units at the tips, and each blade comprised separate inner and outer sections, joined by a muff coupling.

At a gross weight of 31,000 lb, the B.E.A. Rotodyne was designed to cruise at 130 kt. Its range with 30 passengers and 45 min hold-off was given as 160 n.m. A developed version to carry 48-60 passengers over 250-350 mile distances, the Fairey proposal stated, could follow the basic machine described. The powerplants chosen for this development were two Napier Elands, each driving an auxiliary compressor.

A detailed account of the Napier contribution to the subsequent development of the Rotodyne is given in the third section of this Rotodyne report (page 959); and before referring here to the manufacture of the actual machines it is of interest to trace briefly the history of Fairey work on the jet propulsion of rotor blades.

Research on this subject began in 1947. An early project consisted of a small (2,000 lb gross weight) pressure-jet helicopter with a propeller for forward flight, for which the development of a flat rich-mixture combustion chamber for 75 lb thrust was carried out at Hayes. Air for the static tests was supplied from the factory's compressor plant, and a 10ft single-blade rotor with a Merlin blower driven by a 50 h.p. electric motor was used for spinning tests.

As well as the development of a pressure-jet unit, research into ramjets and pulsejets was carried out on the static and rotating rigs. Work on these types of tip-jet units was abandoned at the end of 1950 when it became obvious that the pressure-jet principle was more suitable for large single-rotor helicopters. The 2,000 lb project was dropped in favour of larger transport helicopters.



Among design studies which preceded the current Rotodyne (below, right) were the Leonides-powered 15-seater of 1949 (left) and a 40-passenger machine of 1952 (below) powered by projected de Havilland units. Both featured tip-jet units. The drawings are approximately to the same scale.

"Flight" photograph

To gain experience on the tip-jet drive and on the transition procedure between hovering (with powered rotor) and forward flight (with tractor propellers and windmilling rotor), the Jet Gyrodyne was conceived. The second Gyrodyne prototype (both were originally fitted with a shaft-driven three-bladed rotor and single combined torque-reactor and tractor propeller) was modified to tip-jet propulsion. The rotor gearbox was replaced by two modified Merlin superchargers, and two pusher propellers were mounted on the stub wings. The three-bladed shaft-driven rotor was replaced by a two-bladed rotor with pressure-jets at the tips; ducted hub; ducted flapping, feathering hinges; and ducted blades.

For the development of the tip-jet units for the Jet Gyrodyne and subsequently the Rotodyne, new test facilities were set up in 1951 at White Waltham aerodrome. Those comprised a small static test stand and a rotating rig suitable for Rotodyne chamber spinning tests. A Dart engine with air tapped from the combustion chambers was used as a compressor plant for the static rig. Two other Dart compressor plants were used for the air supply to the rotating stand on which a single-bladed and balanced rotor (with hingeless hub) was used to investigate light-up, regulation, performance, cooling and stressing of the unit during rotation.

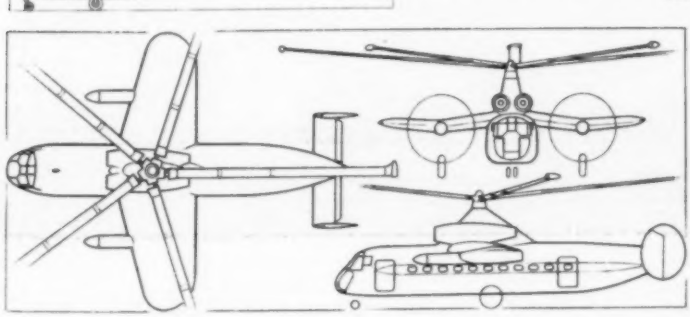
Prior to installation on the aircraft, a complete Gyrodyne rotor including hub, blades, jet units and controls was installed on this rig for functional and performance testing. The Gyrodyne chamber and rotor were completely developed by the end of 1953 and the Jet Gyrodyne flew in January 1954.

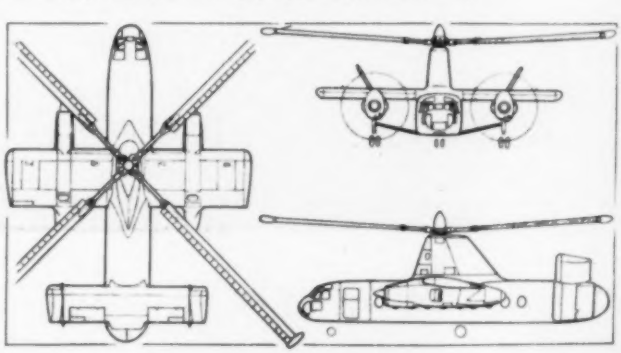
Meanwhile, with the appearance of the B.E.A. specification and the switch to the 40-seat version of the Rotodyne, an expansion of pressure-jet test facilities was planned. Development of the combustion chamber and rotor for the Fairey Ultra-light helicopter took place on the existing rigs, and new test stands were completed at White Waltham in September 1955 and April 1956.

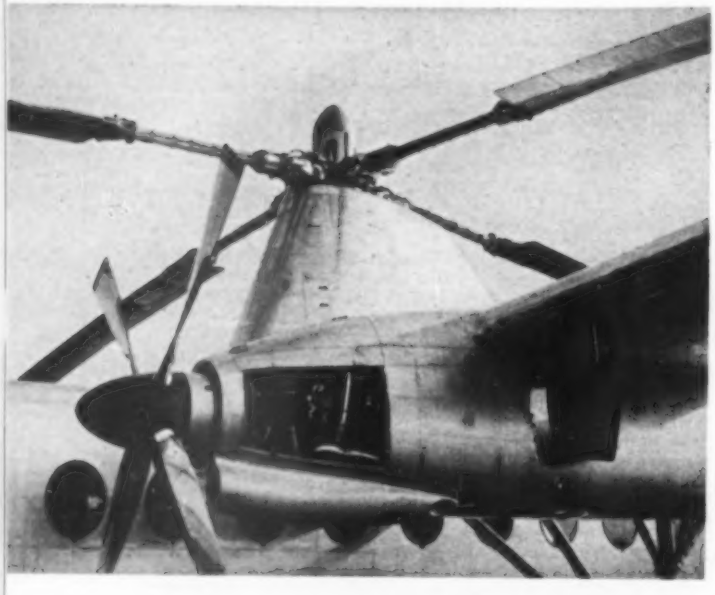
In addition to the testing of Fairey pressure-jets in combination with the Napier Eland powerplant at White Waltham, a most realistic test installation was set up more recently by Fairey at the Aeroplane and Armament Experimental Establishment at Boscombe Down. This comprised the complete powerplant, rotor and flying and powerplant control system exactly as on the aircraft itself—everything, in fact, except the airframe. In April of this year running commenced, with S/L. Gellatly "flying" the rig in all cases except the ordinary engine-runs. A comprehensive test programme (limited only by the financial limitations of the M.o.S. contract) has since covered the powerplant, rotor, tip-jet units and their respective controls. (Photograph of Boscombe rig, page 960).

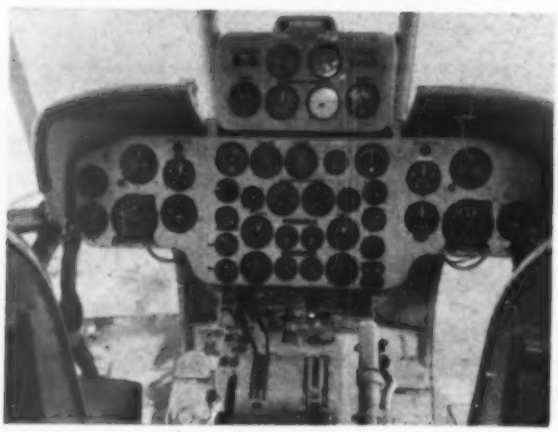
It was in the latter part of 1953 that the M.o.S. contract for the construction of the first Rotodyne was received. There were few major changes in the design—or at least the outward appearance—of the Rotodyne after the adoption of Napier Elands as the powerplants, for the Fairey company had already firmly established their chosen configuration and most modifications were of a detailed nature. The four-bladed rotor having been adopted, it was decided to use one-piece blades instead of jointed two-section units (the original intention was that the outer section would consist of the Jet Gyrodyne blade). A larger duct area was desired, together with development scope for future tip-jet units, and so the change was made from a single duct to triple tubes, and the rotor hub was redesigned. Instead of following Jet Gyrodyne practice, and to reduce bulk and weight, the design was changed to

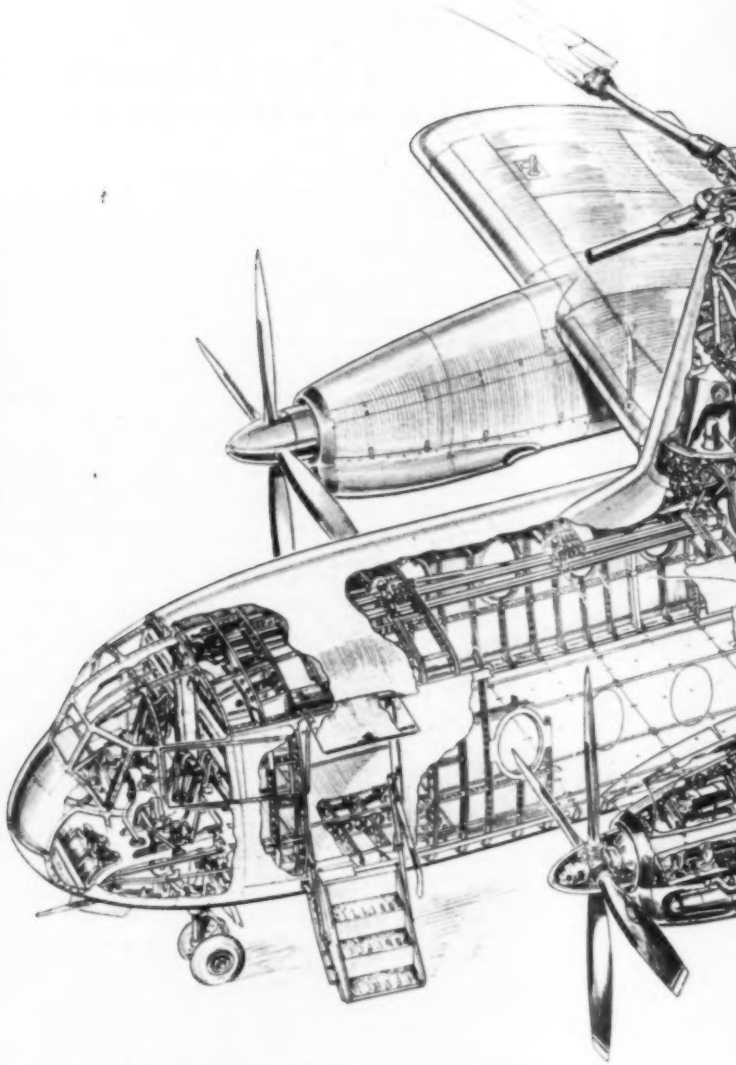
(*Continued on page 958, after double page of Rotodyne illustrations*)











ROTODYNE REPORT . . .

Dimensions and weights: Fuselage length, 58ft 8in; height overall (to top of rotor head), 22ft 2in; fuselage interior, 46ft long, 8ft wide, 6ft high; floor height above ground, 3ft 5in; wing span, 46ft 6in; wing gross area, 475 sq ft; rotor diameter 90ft; disc loading, 6.14 lb/sq ft; blade chord, 27in; Rotol propellers, 13ft diameter; gross weight, 33,000 lb (prototype), 39,000 lb (production); payload (production), 7,400 lb

Basic performance (estimated): cruising speed, 170 m.p.h.; payload, 40 to 48 passengers for ranges up to 430 miles; vertical rate of climb at sea level at maximum power, 1,670ft/min; direct operating cost per passenger mile, about 3 pence at 100 miles range, falling to 2½ pence at 250 miles and 2.3 pence at 450 miles.

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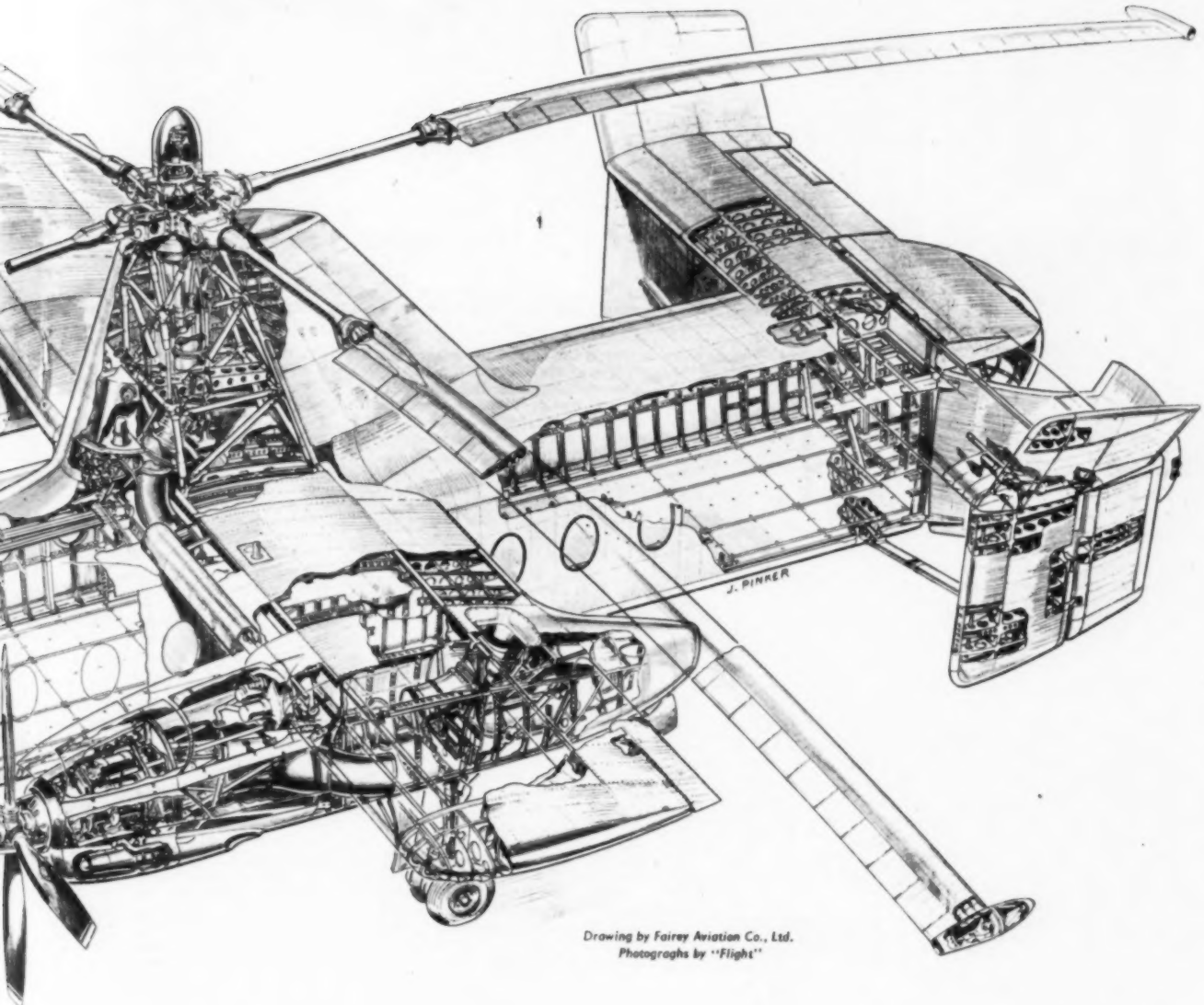
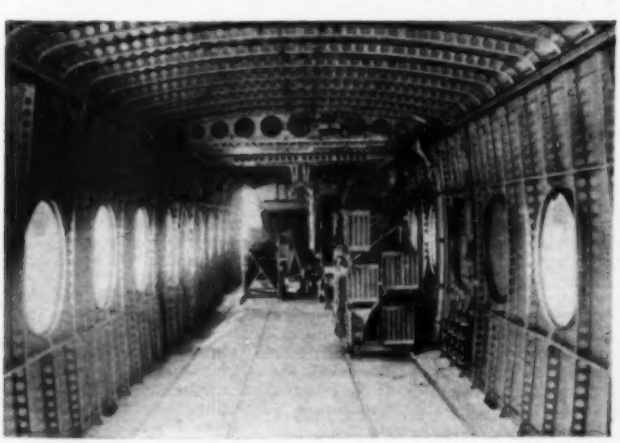
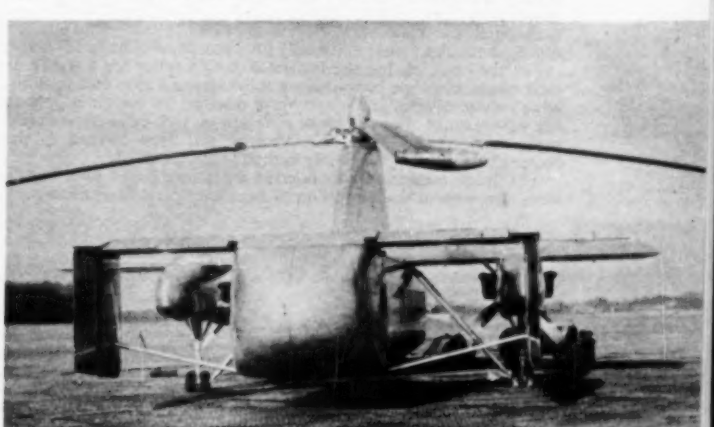
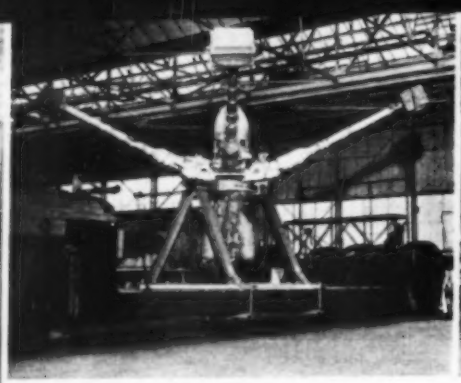


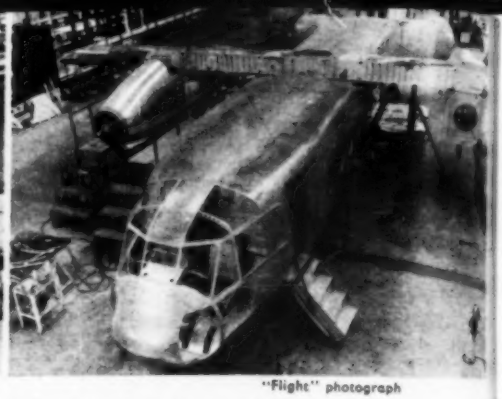
Drawing by Fairey Aviation Co., Ltd.
Photographs by "Flight"

Main constructional features of the Fairey Rotodyne are indicated in this cutaway drawing and the photographs. Further details, and annotated cut-away, were included in "Flight's" full technical description of the machine, which appeared in our issue of August 9. The aircraft is powered by two Napier Elands each of 3,500 h.p. and four Fairey tip-jet units (tip speed 720 ft/sec). The rotor head is power-operated and of all-steel construction; fuel is carried in bag-type tanks mounted in the wings. The propellers are used conventionally for cruising flight, differentially for yaw control at low speeds.









"Flight" photograph

Rotodyne manufacture: left, a skeleton form of envelope jig used; centre, the rotor head, which formed the main manufacturing problem; right, the complete machine taking shape at Hayes.

Rotodyne Report . . .

incorporate top-mounted swashplate and actuating linkages, and a control transmission by means of central concentric torque-tubes.

A comprehensive programme of wind-tunnel testing was carried out at Hayes, using a $\frac{1}{4}$ scale model (less rotor) and a $\frac{1}{12}$ scale model complete with rotor. It was as a result of tunnel investigations of Rotodyne behaviour in the engine-cut case that the only major airframe modification was made. This was the addition of the upper (inclined) fin sections. The second Rotodyne was ordered by the M.o.S. in August 1954, and is now under construction.

The manufacturing aspects of the Rotodyne's development were described recently by Mr. F. H. Parker, engineering manager of the company. Three years, six months and nine days elapsed, he pointed out, from the receipt of the first working drawing to the first ground run of the completed aircraft on October 24, 1957.

Production of wing, tailplane, fins and rudders were subcontracted to the company's Stockport works. All other airframe components, including the undercarriage, were manufactured in the Hayes experimental department and were of orthodox construction (a full technical description of the Rotodyne appeared in our issue of August 9, 1957). A skeleton form of envelope jigging, using local strip plates rather than a complete envelope for the drilling pattern, was used for the fuselage; all other major contoured components were made in standard Fairey envelope jigs.

The rotor head and head mechanism was regarded as the main manufacturing problem. New machine tools were installed expressly for the machining of components for the rotor head, although a large percentage of major machined fittings were to be subcontracted to specialist tool-makers. For the first aircraft, two complete heads and control systems had to be built, one for test and one for flight. Test rig components and structural test pieces accounted for almost a third set of head details.

Materials procurement for the rotor head involved large steel forgings, weighing up to 14 cwt, complex light-alloy castings and a wide variety of light-alloy and steel rolled materials.

The tubular structure of the rotor pylon also presented difficulties. Most of the tubes were required to be of 17 s.w.g. for short lengths at either end, with the main intermediate section reduced to 22 s.w.g. The tubes were up to 8ft in length and were of T.60 steel. This butting requirement exceeded the normal practice of British tube-makers, and a very high finish was demanded for maximum fatigue properties, but tubes to the required standard were eventually produced by Accles and Pollock.

For the rotor blades, the projected design called for a stainless-steel blade envelope containing a solid forward spar and leading-edge ballast weight, and a system of ducting for the air supply to the tip-jet units. For the blade envelope, a high-strength stainless steel was produced by Firth Vickers and draw-formed to the required section by the Fairey company.

The leading-edge spar demanded a 35ft section of high-tensile steel. Because of the limitation of heat-treatment equipment such a length had apparently never before been produced, and the steel suppliers were reluctant to take on the job. This problem was solved with the help of the English Steel Corporation, after investigating a system of resistance-heating for the complete hardening and tempering process.

For the blade air-ducts, stress-distribution and weight requirements necessitated the use of stainless-steel tubing, its thickness tapering in stages from root to tip. In spite of the difficult nature of the job (the tubing was approximately 3in in diameter, 34ft long and 0.015in thick at the outer end), production was successfully accomplished by Accles and Pollock. For blade assembly, a Fairey envelope jig was chosen with the elements manufactured in reinforced glass-fibre.

The early development of tip-jet units for static test was carried out with low-grade stainless steel until the evolution of the final design. The major components of the flight-type tip-jet units were fabricated from Nimonic alloys, and welding was widely employed. The machining of Nimonic components was relatively easily overcome, but the welding necessitated the use of special D.C. argon-arc welding equipment and the development of rigidly controlled processes. For future ease of manufacture, automatic welding processes are being developed; and investigations are being made into alternative materials for the improvement of heat distribution in an attempt to extend the working life of the units.

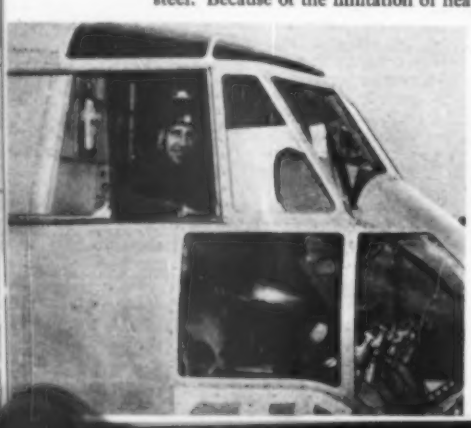
On November 6, 1957, Rotodyne XE 521 flew for the first time, 13 days after its first ground running. The place was White Waltham, the pilot S/L. Ron Gellatly. Three flights, including a circuit of the airfield, were made on that morning. Well over 20 flights have since been made, each of fairly short duration. No major snags have been encountered, and the Fairey team is moving ahead methodically, exploring the flight envelope in stages.

First flights have been made with a rigid jury-strutted undercarriage, in order to eliminate ground-resonance effects from the early investigations of basic flight properties. Forward speeds up to 60 kt (in helicopter flight) and vertical speeds of up to 500ft/min have been investigated. Rotor stresses and powerplant and rotor control behaviour are being studied. The next stages of performance and control testing will probably be up to 80 kt forward speed, then up to 100 kt, and then transitions from rotor-power to propeller thrust (with the rotor autorotating) and *vice versa*.

The general object of the flight-testing of this first Rotodyne is to explore the existing novel features of the type (and in particular to prove the control system) and to establish safe component lives. S/L. Gellatly has reported the controls to be crisp, particularly in the case of collective pitch and cyclic pitch. Yaw control is certainly adequate at present, but will be improved as logical adjustments to the regimes of rudder and differential propeller-pitch are made. An important basic powerplant feature to be studied is obviously the response and behaviour of the ingenious Rotol throttle-governors.

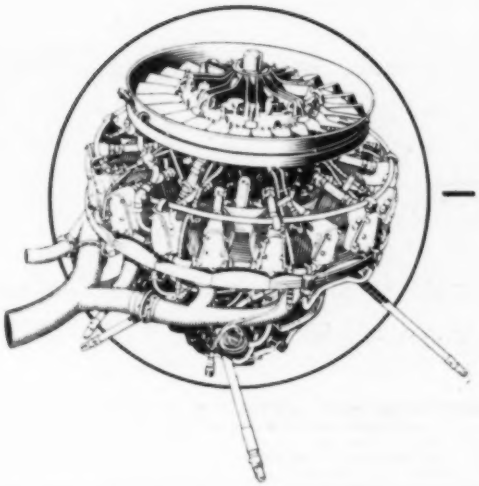
Among present Fairey personnel who, under Mr. R. L. Lickley, the company's technical director and chief engineer, have contributed to the development of the Rotodyne are Dr. G. S. Hislop, deputy chief engineer and chief designer (rotating wing); J. C. D. Cotes, chief development engineer; C. W. Cowle, deputy chief designer; D. M. Davies, senior helicopter project engineer; W. Denyer, designer (mechanical); S/L. R. Gellatly, senior helicopter pilot; Dr. D. B. Leason, head of thermodynamics group; R. G. Maltby, assistant designer (Rotodyne); K. T. McKenzie, chief aerodynamicist; Lt-Cdr. J. Morton, helicopter pilot; F. H. Parker, engineering manager; V. A. B. Rogers, assistant chief stressman; A. Stepan, head of helicopter powerplant and propulsion section; H. H. Tozer, experimental manager, and Dr. H. F. Winny, head of technical department.

Both the existing Rotodyne and the second machine (which will incorporate the larger-section fuselage and should be complete by late 1958) are research aircraft, and it is hoped subsequently to obtain a C. of A. for the type at a gross weight of 39,000 lb. Having built and flown the first machine, the Fairey company is now embarking on the important intermediate phase of thorough detailed testing of the Rotodyne as a flying machine and as a transport vehicle.



The latest stage in Rotodyne development, that of flight testing began on November 6, 1957, with the first flight of the prototype in the hands of S/L. Ron Gellatly, senior Fairey helicopter pilot.

The power behind the lift



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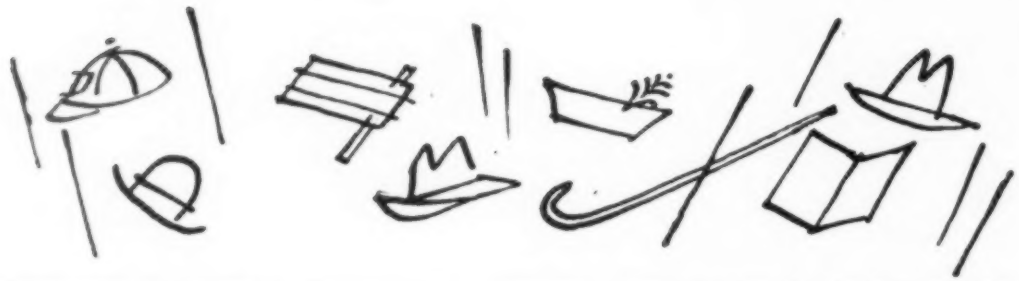

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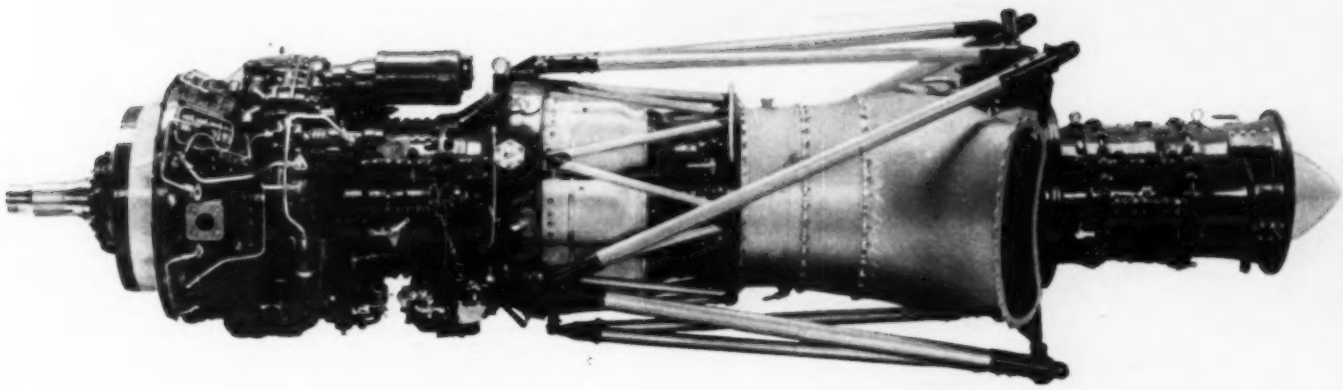


ROTODYNE REPORT . . .

3—THE NAPIER CONTRIBUTION

WHEN Faireys first conceived the Rotodyne in about 1951 they did not select any definite engine. It was designed in various versions around two or three Rolls-Royce Darts, and various other turbines were considered. Each version naturally promised an aircraft with different performance and load-carrying capacities. It was not until British European Airways issued its specification for a 40-seater helicopter with a speed of 140 kt that Faireys crystallized their design and came to the conclusion that the Napier Eland NEl.1 was the only engine of sufficient power, and sufficiently far advanced in development, for installation in the aircraft. It is worth noting that Napiers, who have since produced several powerplants specially for helicopters—the Oryx, the Gazelle and H.T.P. tip-thrust units—first interested a helicopter designer in an engine which was not specifically intended for helicopter use and which, indeed, needed considerable (though comparatively straightforward) modification for the purpose.

Before the B.E.A. specification was issued the only other firm requirement for an aircraft such as the Rotodyne appeared to be that from British West Indian Airways, who were faced with the problem of operating inter-island services from few and small aerodromes. Short Bros. attempted to solve this problem by offering the Sealand amphibian (two 345 h.p. D.H. Gipsy Queens) to operate from sheltered lagoons around the island coasts; but it was soon found that in the engine-out condition the Sealands needed longer lagoons than nature had provided. There still remains the possibility of Rotodynes being supplied to B.W.I.A.

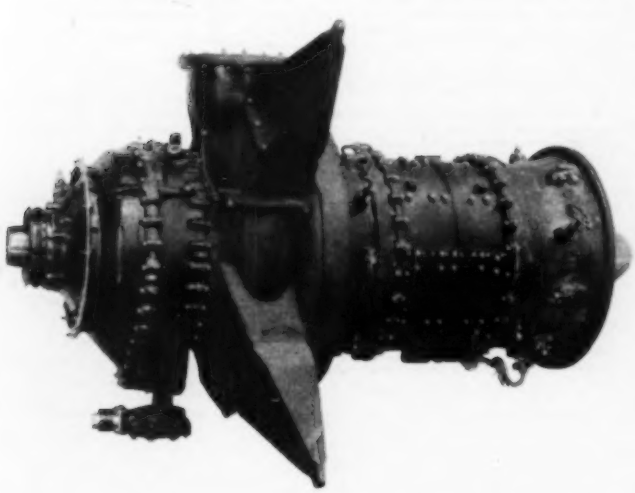
Two main alterations had to be completed on the NEl.1 to fit it for the Rotodyne (and, incidentally, to change it into the NEl.3, by which designation this present version of the Rotodyne's engine is known). First, an auxiliary compressor had to be designed and fitted to the rear end of the engine and, secondly, a hydraulic clutch had to be designed and fitted between the turbine shaft and the new compressor. These were the main alterations. At the same time it was necessary slightly to redesign the rear end of the engine. The jet-pipe had to be bifurcated to pass on each side of the auxiliary compressor; the rear end of the turbine shaft had to be fitted with a gear-tooth coupling to the drive of the hydraulic clutch; and the engine mounting frame had to be modified. The standard tubular engine-mounting frame was lengthened and to it were added four supports to secure the clutch and compressor to the engine. These supports have flexible mountings to allow for the expansion of the compressor and clutch casings during running.

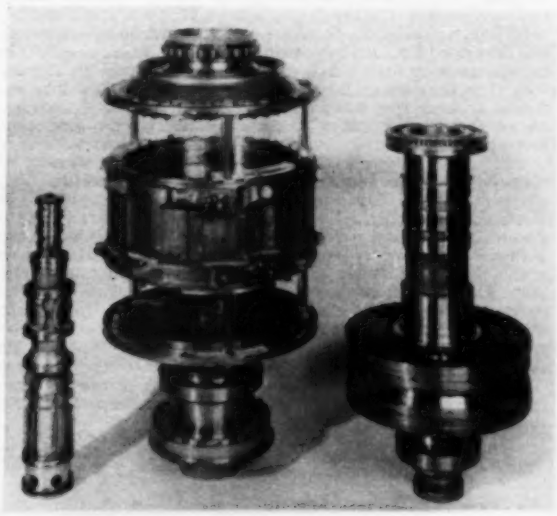
All these modifications interfered very little with the basic design of the Eland. In fact, to the third stage of the turbine, the Rotodyne engine was identical with the standard engine. At the third stage the jet flow diverged instead of converging, and the clutch and compressor were added. The length of the Rotodyne engine is 12ft 2½in, compared with 10ft on the standard Eland, and the net dry weight is approximately 2,400 lb against just over 1,600 lb. This extra length is not an embarrassment in the Rotodyne because it is easily accommodated in the long nacelles which are necessary to place the undercarriage well back.

The auxiliary compressor is of the constant-outside-diameter type, and has nine stages—one less than the Eland's main compressor at the front. This compressor is, of course, used only for vertical or steep climbing flight and 80 per cent of the Eland's power may be used. Air is aspirated from the rear of the engine through a special intake on top of the Rotodyne's wing directly

[*Continued overleaf*

The heading photograph shows the Eland NEl.3 as fitted to the Rotodyne. On the extreme right is the auxiliary compressor; forward of it is one of the bifurcated jet pipes. The hydraulic clutch is located between the jet pipes. Below, left, is the complete assembly of hydraulic clutch and auxiliary compressor; clutch details are shown below (right). The three units are the oil transfer tube, input casing and inner output shaft.



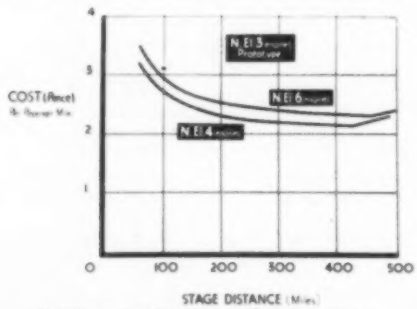


The Fairey spinning rig at the A. and A.E.E., Boscombe Down: the propulsive system is being tested with one Eland and its associated pair of tip-jet rotor blades.

Rotodyne Report . . .

over the engine nacelle, and a few inches from the trailing edge. This auxiliary delivers compressed air only—it does not pass it through any combustion chambers—*via* a double volute to a single exit leading along the front of the wing to the main rotor pylon, and then upwards to the rotor head and out to the Fairey pressure-jet units at the blade tips. In the current prototype each engine feeds two of the four jets, so that in the event of an engine failing only two of the jets will continue to function; but this is considered sufficient to maintain safety. This arrangement, operating in conjunction with similarly duplicated fuel services, does in fact minimize power loss in the event of one engine failing.

Fuel is supplied under pressure to each tip-jet unit, the fuel/air ratio being governed by a variable-datum automatic regulator. Ignition of the mixture of fuel and air is by two high-energy igniter plugs in each unit. Each plug is fed from an independent supply as an insurance against electrical failure. The speed of the rotor is quite independent of engine speed and is, therefore, variable over a wide range. This makes for ease of control and is also a valuable contribution to passenger comfort. The relatively high specific



Rotodyne developments: operating economy.

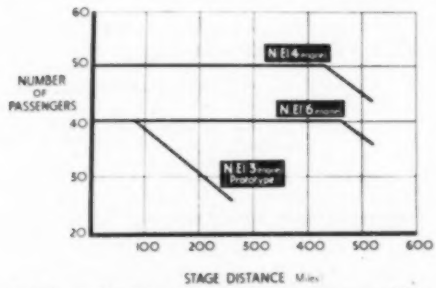
fuel consumption of the tip jets is offset to a considerable degree by the relatively short time during which the rotor head is actually being driven. For most of a typical Rotodyne flight the aircraft will be moved solely by the tractive power of the Elands' propellers. A rotor-driven accessories gearbox ensures that the essential flying controls are unaffected in the event of both Elands failing when airborne. This gearbox is mounted within the pylon structure and incorporates a hydraulically operated friction rotor brake.

Napiers are particularly proud of the hydraulic clutch, which was developed from the basic principle of the Sinclair clutch. The requirement was for a clutch with the minimum possible slip and with great flexibility. Obviously it had to be of the hydraulic and not the friction type; it had to be able to deal with 2,800 shaft h.p. on the early engine (more on those planned for the production Rotodynes) and 12,500 r.p.m.; and, clearly, it would have to be cooled. In all, it was a difficult proposition but one with which Napiers, with their long tradition of precision engineering, were well able to deal. The vanes of the clutch were designed to be shrouded and cooling oil was passed between the vanes and the shrouds. All this was required within an extremely small diameter to fit in between the jet-pipe bifurcation. In the event the diameter of the clutch was a mere 12in. This hydraulic clutch coupling is supplied with oil from the engine pump. The pressure oil pump, torquemeter pump and scavenge pumps are driven from a shaft at the rear end of the propeller shaft. The oil pressure, torquemeter and main scavenge pumps are of the gear type and the auxiliary scavenge pumps for the bearings are of the vane type.

One other modification which had to be made for this Rotodyne engine was in the engine controls. It took the form of an automatic unit which ensures that in the event of one engine failing power is increased on the other. Comprising an interconnected propeller control and fuel metering unit, it also, of course, compensates for variations in altitude and forward speed. A separate control is provided for the hydraulic clutch.

Rotol propellers are fitted to the Rotodyne's Elands, in contrast to the de Havilland products which are used on the Elands flying in the Napier Convair that is now undergoing its C.A.A. acceptance trials at Santa Monica, California. Originally Rotol were doing all the development work on the Eland propellers. Few details of the reasons for the change-over from one make of propeller to another are available, but as Rotol did the original work on the Eland propellers it is possible that they developed extremely fine pitch stops, which would be very necessary in this particular helicopter application of the Eland.

Even today the Eland is still the only turboprop engine available



Rotodyne developments: passenger-carrying ability.

in Britain which is suitable for the Rotodyne. This article has dealt with the 3,000 e.h.p. NEl.3 unit, but development has been pushed ahead on more powerful versions of the engine, in particular the NEl.6 of 3,500 e.h.p., which in its Rotodyne form is known as the NEl.7. This is destined to be fitted to the production Rotodynes and development is going ahead (with official British Government encouragement) following the success of the initial flight tests of the Rotodyne—and also as a result of the encouraging reception which Napiers are at the moment receiving from North America and other parts of the world now that their Convair is showing its paces.

One other version of the Eland, the NEl.4—the "hot" version of the engine—was at one time considered for the Rotodyne, but lack of Government funds forced Napiers to shelve this design. It is, however, not so much a skeleton in the cupboard as a well-preserved corpse which could be revived by the gentle application of Treasury massage. This engine, as is shown in the accompanying diagram, would have bestowed considerable additional load carrying capabilities on the Rotodyne.

The Eland was initially started as a private enterprise by Napiers with, of course, the full backing of their parent firm English Electric. The first standard Eland ran for the first time in September 1952, and began its flight trials in a Varsity test-bed in July 1954. At the end of that year it successfully completed, at the first attempt, a 150-hour rehearsal type test at the full NEl.1 rating. The first Rotodyne-Eland began running in March 1955 and since then many hours have been accumulated on the Napier test-beds at Coronation Road, Acton, and at Hatfield.

Napier NEl.3 Data

Length (front of propeller shaft to auxiliary compressor inlet flange)	146½in
Max. diameter (excluding mounting frame)	36in
Net dry weight (including mounting frame but without final jet-pipes)	2,400 lb (estimated)
Engine compressor flow (take-off condition)	31 lb/sec
Auxiliary compressor flow at max. cont. rating	18.5 lb/sec
Auxiliary compressor overall pressure ratio at maximum continuous rating	3.9:1
Centre of gravity, distance forward of engine mounting point	58½in (approx.)
Engine rotation (viewed from rear)	Left-hand
Max. engine speed	12,500 r.p.m.
Max. take-off power	2,805 s.h.p. plus 500 lb thrust
Max. take-off power (tropical, 45 deg C)	2,185 s.h.p. plus 410 lb thrust
Max. take-off power (Arctic, —26 deg C)	3,000 s.h.p. plus 585 lb thrust
Max. continuous power	2,180 s.h.p. plus 420 lb thrust
Max. recommended cruising	1,710 s.h.p. plus 355 lb thrust
Fuel consumption at max. recommended cruise	1,300 lb/hr
Specific fuel consumption at max. recommended cruise	0.760 lb/s.h.p./hr
Fuel	Wide-cut gasoline, or Avtur

GAS TURBINE DEVELOPMENT

Further Abstracts from Hayne Constant's Sir Henry Royce Memorial Lecture

IN our first series of abstracts from Mr. Hayne Constant's Sir Henry Royce Memorial Lecture, published last week, an account was given of some of the development work carried out at the National Gas Turbine Establishment, Pyestock, on compressors and turbines. The next section of the paper (which was delivered before the Derby Branch of the Royal Aeronautical Society) was concerned with the improvement of turbine cooling to make possible the use of higher gas temperatures. After describing the initial approach to this problem, in 1946, the lecturer referred to the construction of an experimental cooled turbine and a cascade tunnel with cooled blades. After unrewarding work with free convective cooling and liquid cooling, it was decided that an air cooling technique was the most promising.

THE first tests on an air-cooled turbine [continued the lecturer] were made in 1952 and the first runs with a mean gas temperature of over 1,100 deg C in 1953. Since then much further work has been done on turbines operating under a variety of conditions (Fig. 6) and at higher gas temperatures. In parallel with the experimental work on the cascade rig and the air-cooled turbine, analytical work was needed to build up a supporting theory. At the same time subsidiary tests were done on a water-cooled turbine and on one whose blades were cooled by a water spray; and novel methods of constructing cooled blades, e.g., the use of lost-wax castings, were developed. All this was real pioneering work carried out some years in advance of anyone else, work which I think has resulted in our gaining a reasonably exact understanding of the problems of turbine cooling. (Refs. 9, 10, 11.)

While this work on the turbine was going on we spent some effort on the related problem of cooling the walls of ducts, such as the flame-tubes of combustion chambers. A criterion of cooling effectiveness was developed and this was used to compare the relative efficiency of a number of different cooling systems. As a result of this work we suggested in 1950 that the best practical method of cooling a duct was by a series of films of air, bleeding into the hot gas stream, fed from a chamber so jacketed as to give good convection cooling. We have since successfully used this combination of external convection cooling and internal boundary-layer or film cooling on a number of occasions.

Combustion. *The lecturer next turned to work on combustion carried out at Pyestock during the past 20 years, referring to analysis methods employed to isolate the various physical and chemical processes that occur in a combustion chamber. As examples he cited the study of the burning of individual droplets of fuel and the determination of ignition delays.*

The filling in of basic data on elementary combustion processes such as these [continued Mr. Constant] is gradually giving perspective and balance to the view of the combustion engineer and enabling him to make his judgments on a quantitative basis. A good example is the success that has attended our efforts to define precisely the effect of linear scale in combustion chambers (Ref. 12). Our early work gave the first effective analysis of the significance of linear scale in high-speed combustion processes and showed how model tests could be used to simulate full-scale performance. Later work by ourselves and others—notably Rolls-Royce—has extended our understanding by explaining the effects of fuel injection and heat transfer.

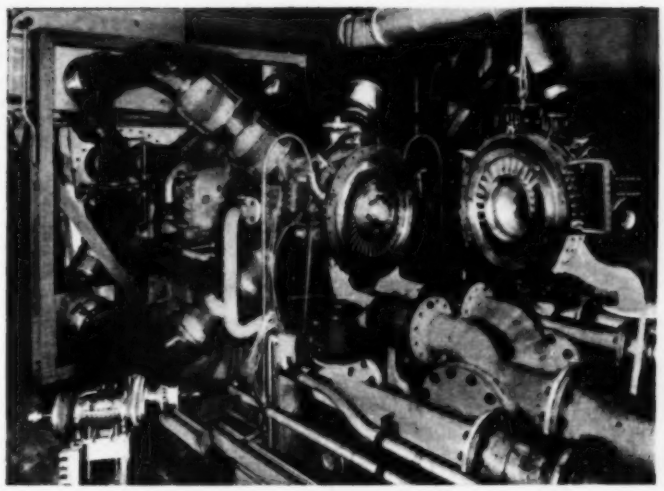


Fig. 6. Test rig for air-cooled turbine.

For some years we have been trying with some success to make more rapid progress in increasing the rate of heat release from a chamber. The most recent and most notable advance here has been a chamber having a heat release of 6×10^6 CHU/cu ft/atm/hr—if I may be permitted to use a rather unfashionable criterion—about three times that of current chambers, without a penalty being paid in other aspects of its performance. This great compactness has been achieved by building into a single chamber four novel features (Fig. 7). The first of these is the elimination of the compressor diffuser, thus shortening the length of the chamber. The secondary air is led straight through the chamber at high velocity to a sandwich mixer, in the cool-air passages of which lie the turbine nozzles. Mixing of secondary and primary air takes place in the nozzles, which are at the same time effectively cooled. Uniform peripheral distribution of fuel into the annular primary zone is effected by dispensing with the normal type of injectors and passing the fuel off the lip of a spinning disc. The turbulence in this primary zone and the strength of the stabilising vortex are increased by paddle wheels attached to this disc. This may prove to be a revolutionary step forward in combustion chamber design.

Reheat. Work started in 1943 with an attempt to check by experiment the theoretical prediction that increased thrust should result from burning fuel after the turbine and before the propelling nozzle.

The first experiments were done in an air supply simulating, as we thought, the conditions in the exhaust pipe of a jet engine. These experiments led us to the conclusion that it would be possible to burn fuel in the exhaust in spite of the very high gas velocity. A Power Jets W.1A engine was then obtained and the first reheat combustion system was built into its exhaust pipe. The main feature of the system was the perforated pilot chamber formed as an extension of the exhaust bullet. Within this chamber were mounted a sparking plug for ignition and an upstream pilot jet. Downstream of the pilot chamber was a single main jet which directed a spray of fuel into the pilot chamber. Results were sufficiently promising to justify going ahead.

Reheat was forced into the air before its time by the flying-bomb attacks on London in 1944. Although these attacks were repulsed before reheat could be demonstrated in action a significant improvement in aircraft performance was obtained. The

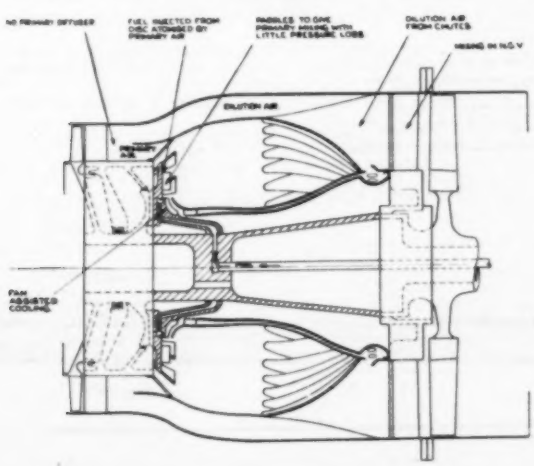
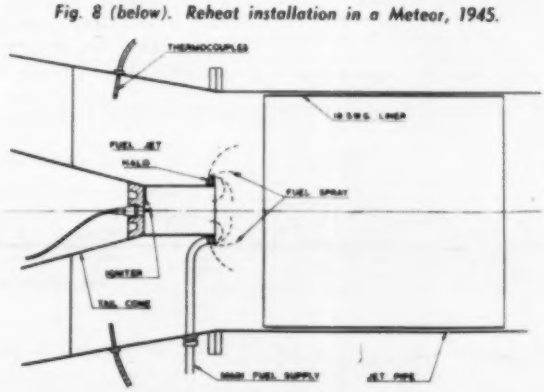


Fig. 7 (left). Details of compact combustion system.

Fig. 8 (below). Reheat installation in a Meteor, 1945.



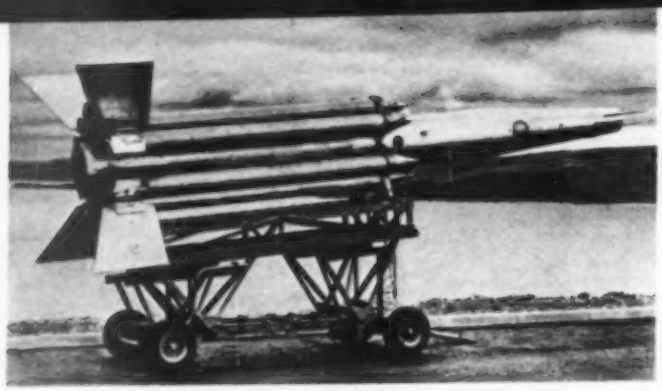


Fig. 9. Ramjet test vehicle.

GAS TURBINE DEVELOPMENT . . .

aircraft used was a Meteor 1, fitted first with Rolls-Royce Welland engines and later with Power Jets W.2/700s. With these last engines reheat gave a speed of 500 m.p.h., an increase of 46 m.p.h. over that achieved without reheat (Fig. 8).

From the Meteor tests came realization of the limitation on performance imposed by the pressure in the exhaust system, it being found difficult to get reliable operation much above 30,000ft. At roughly the same time it was realized that it would not be possible to spread the flame from a single central flameholder and that a multi-stabilizer system would be necessary if large increases in thrust were to be obtained. In order to overcome these two difficulties a fresh start was made in 1947 with a new combustion system borrowed from our ramjet developments. In this system fuel was injected upstream from a number of jets placed in the exhaust diffuser. A number of conical stabilizers, each carrying ignition sparking plugs, held the flame in a plane some four feet downstream of the main jets. With this system, and developments of it, a good performance over a wide range of conditions was obtained on W.2/700 engines. In flight it was found that the system was capable of operating at exhaust-pipe pressures equivalent to an altitude of about 49,000ft. It was also found that by staging the fuel supply to the separate jets a continuous variation of thrust boost from 2½ per cent to 30 per cent could be obtained (Ref. 13).

By 1951 it seemed that the back of the problem had been broken and that it would be reasonable for us to transfer our effort to other work, leaving the further development and application of reheat to industry. (The application in this country has not in fact been as rapid as we had expected.)

Ramjets. We began work on devices of this kind—which we then called propulsive ducts—in the early days of the war, foreseeing their future as thrust boosters in aircraft. In 1944 the first British ramjet did its bench test at Pyestock and was flown in a Mustang aircraft in 1946. Although this first attempt was hardly a success, we produced in 1945 another design which actually achieved its design thrust. This little 7.2in-diameter unit was, however, not large enough to give more than a demonstration of the possibilities of this form of propulsion. In 1950 ramjet work was given overriding priority in the Establishment and a properly instrumented unit of 16in diameter was started. The general objective which we set ourselves was to design, build, test and fly a missile type of ramjet, to see what the problems and difficulties were, and to overcome them; at the same time collecting what basic data appeared necessary. We have, I think, succeeded in doing this and have demonstrated a ramjet propulsion system operating with first-rate performance over a wide range of flight conditions up to Mach = 2.5 and 60,000ft (Fig. 9).

In this ramjet we have used for the first time a two-stage combustion system in which the cruise-fuel injector acts as a pilot and is kept in continuous operation, the second-stage injection being used only during take-off and climb. This idea is slowly becoming accepted as essential for a propulsion system which is required to give good performance over a very wide range of conditions.

We also demonstrated in this test vehicle the first internally cooled jet-pipe capable of operating at stoichiometric mixture strength.

Nozzles and Spoilers. A thrust spoiler developed in 1944 (Fig. 10) was the first device of its kind to be produced in this country, and possibly in the world. It worked quite well, first on a W.2B engine and later on a W.700. It was developed on the test bed and then flight-tested in a Wellington flying test-bed. We had originally intended to try it out next in the Supermarine Attacker, but doubts about the ability of the aircraft to withstand

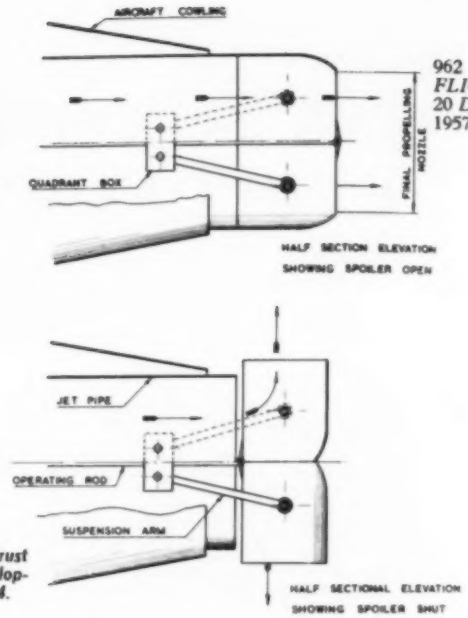


Fig. 10. Thrust spoiler developed in 1944.

the buffeting which it was expected it would receive caused this plan to be dropped.

As a contrast, one of the most recent demonstrations of the Establishment is an attempt to solve the problem of the variable-area propelling nozzle for ramjets, capable of operating at stoichiometric mixture strength. It seemed to us that the most likely solution to this problem would be one based on the centre-plug arrangement with axial movement, similar to that developed for the Jumo engine during the war. The main disadvantages of this arrangement are, firstly that in order to operate at the highest temperatures that can be developed by hydrocarbon fuels it is desirable to avoid supports spanning the hot gas stream. This involves mounting the bullet on a long sting-like structure carried to a locating point upstream of the flameholders. The other disadvantage is that the ratio of minimum to maximum throat area is not quite as small as one would have liked.

A nozzle of this kind was designed and made last year for our 16in ramjet engine (Fig. 11). It was constructed on flight scantlings with full allowance for acceleration loadings and weighed 90 lb. The stalk and plug are air cooled and require about 4 per cent of the air throughout to maintain the surface temperature at a level of about 1,000 deg C. The nozzle has been tested at stoichiometric mixture strength giving a gas temperature of about 2,000 deg C with a pressure level of 47 lb/sq in absolute. The behaviour was really very good, vibration being small and the strip condition satisfactory.

Engine-assisted Lift. Our first contribution to engine-assisted lift was the development of the switching boxes used in the jet-deflection Meteor aircraft which flew in May 1954. This was the first occasion on which an aircraft had flown with jet-assisted lift. More recently we put forward the suggestion that the engine exhaust should be emitted from the trailing edge of the wing in a thin sheet, and showed by wind tunnel tests what large increases in lift coefficient could thus be obtained (Fig. 14). This idea, which has been called the jet flap, was of immediate interest to the aerodynamicist in providing a new approach to the concept of fluid flow past an aerofoil. It is conceivable that it will in time prove to be the essential feature of a practical method of reducing landing speed.

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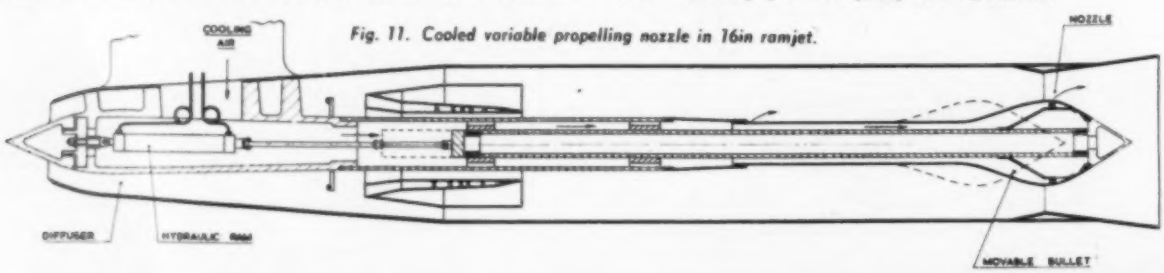
Fig. 11. Cooled variable propelling nozzle in 16in ramjet.



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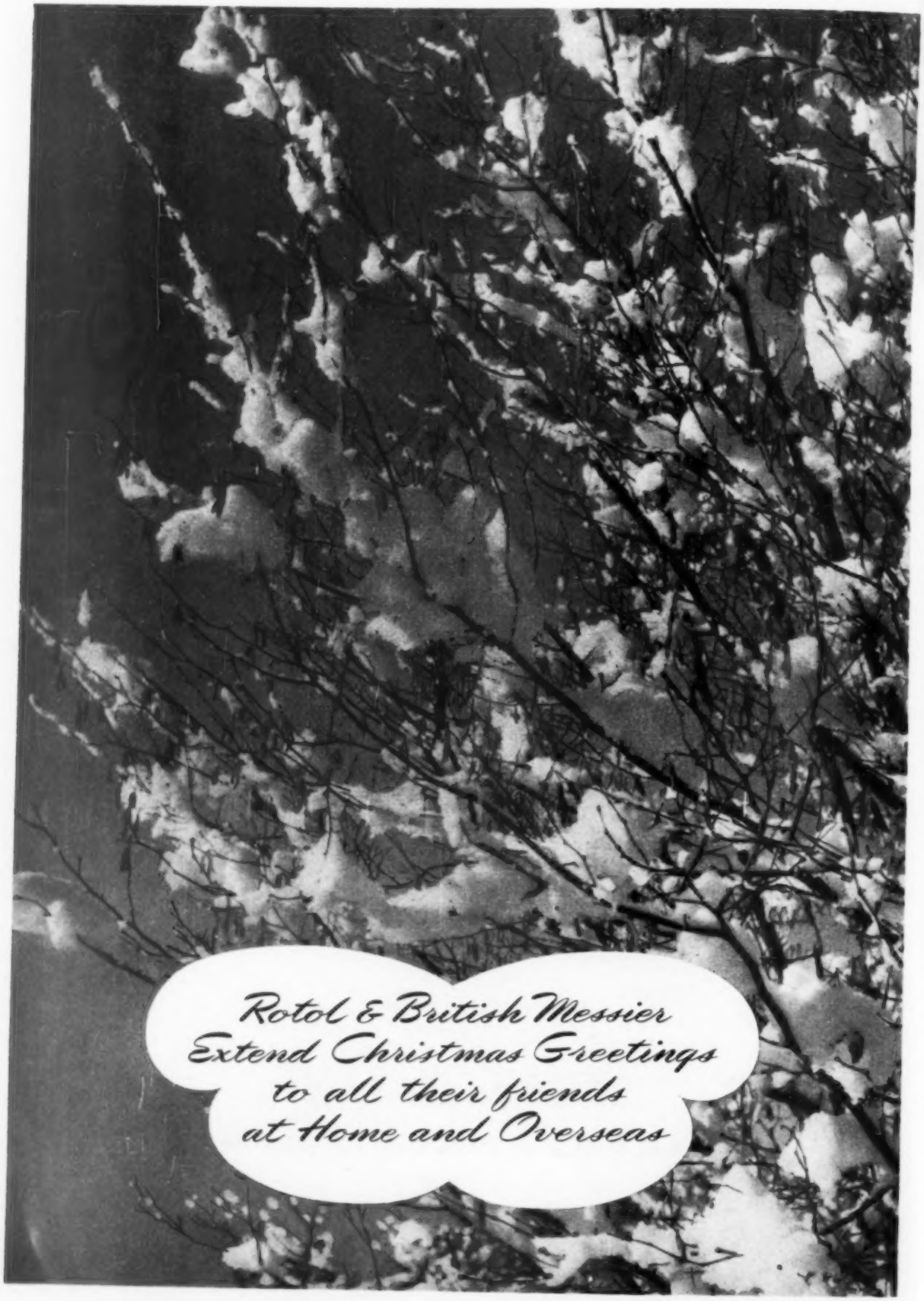
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Jet-age Runway Problem Solved?

"Flight" Reader Offers Two Space-saving Solutions of Breathtaking Simplicity

MUST airports continue to grow bigger and bigger? Need runways get longer and longer? It looks as if the ever increasing speed of jet aircraft must be matched by ever increased length of runway to get the aircraft into the air and down again with an adequate margin of safety. While it is true that much thought is being given to VTOL (and developments are not unpromising), it would seem that conventional designs of jet-propelled aircraft and the straightforward landing run and take off will be with us for a long time. The questions are, what length of runway must be provided at major airports to accommodate future jet transports, and what are the limiting factors? Obviously there is a limit to the amount of land available in the heavily built up countries of industrial Europe. London Airport covers four and a half square miles of land of high value. The capital outlay involved is enormous and few municipalities would be able and willing to find the money for aerodromes of this size, even if the requisite sites could be found. The same limiting factors obtain in some degree in extending existing aerodromes.

Consideration of these and allied problems has led the author to the conclusion that the upper limit of runway length and aerodrome size is already in sight. With some diffidence, he offers an entirely new approach to the problem.

A circular configuration would appear to solve at one time the problem of runway length and ground area. Fig. 1 shows the diameter of an entire airport as 1,000 yd and having an area of

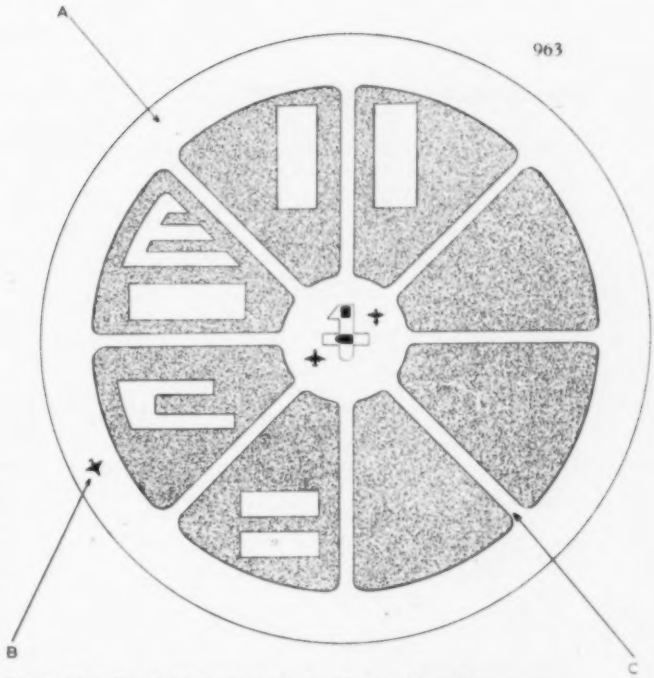


Fig. 1. Plan view of the Tempest circular airport with endless runway. One lap=two miles. Total area of site, 165 acres only. A, banked circular runway; B, aircraft begins take-off run downwind (thus gathering flying speed more quickly) and takes off on opposite side of airport into wind; C, direct radial taxi-track, particularly valuable in fog.

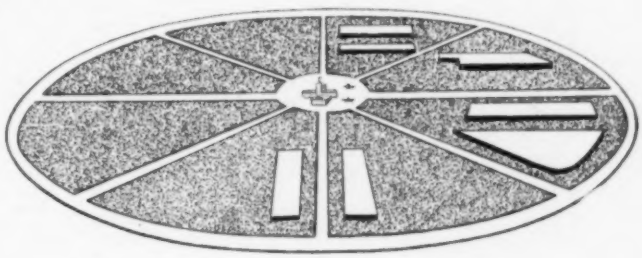


Fig. 2. Perspective view of the proposed airport.

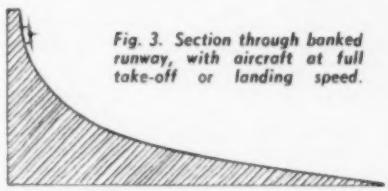
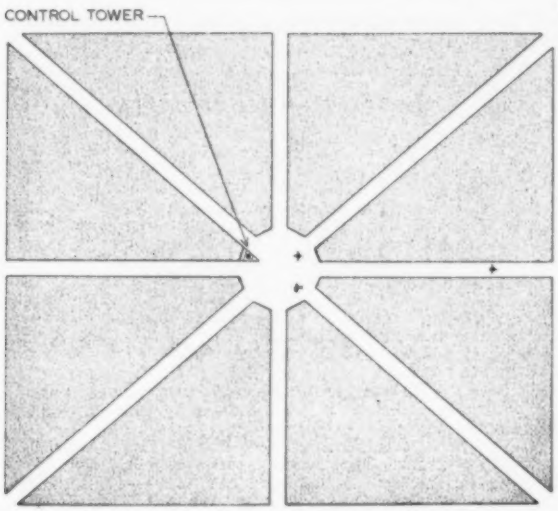


Fig. 3. Section through banked runway, with aircraft at full take-off or landing speed.



Figs. 4 and 5. Plan and (below) enlarged elevation of Tempest Scheme 2, the elevated airport, of less than 200 acres. Gravitational effects serve both to accelerate landing runs and to shorten take-offs. The plan form, incidentally, would be of navigational value in assisting pilots to recognize the airport as being of British nationality.

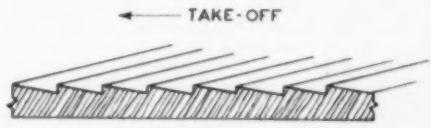
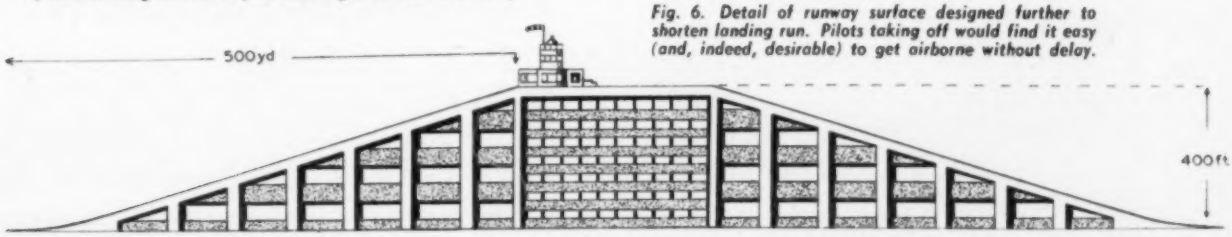


Fig. 6. Detail of runway surface designed further to shorten landing run. Pilots taking off would find it easy (and, indeed, desirable) to get airborne without delay.



Jet-age Runway Problem Solved? . . .

only 165 acres (one-quarter of a square mile). Yet the length of the perimeter, i.e., the runway, is approximately two miles—long enough for most aircraft of today, but more important, probably long enough for the aircraft of tomorrow. The circular format implies that the runway is in fact "endless," and thus provides for a run of one mile, two miles, or indeed ten miles if necessary.

As will be seen from Fig. 2, this runway is steeply banked. Aircraft are thus enabled to touch down at very high speed; and if the banking is vertical at the outside edge, it will be impossible to leave the runway no matter how fast the aircraft is travelling. On the other hand, take-off should present no problem, since it is only necessary to continue round the endless track until safe flying speed has been attained.

An encouraging line of thought arises from consideration of an "endless" runway of this type. It is impossible to overshoot, whether on take-off or landing; and it must surely be equally impossible to undershoot. The conventional straight runway is inherently difficult in this respect, since it must start somewhere more or less suddenly and come to an end more or less equally abruptly.

The circular runway implies, however, a different approach-pattern. Aircraft arriving over the airport will lose height in a spiral glide directly over the runway throughout the landing. Undershooting, as stated, is thus impossible. Pilots will gain in confidence in bad weather in the knowledge that their glide-path is free from obstructions, and throughout the approach the control tower is only 500 yd away on the pilot's port side.

The capital outlay in this type of aerodrome must be considerably less than for large airports such as London—which has, for example, no fewer than six runways—the saving in valuable land requirements alone being enormous. Where capital cost is not a limiting factor, however, or can be recovered by means other than from the air transport industry, consideration may be given to another attempt to solve the problems already touched upon.

The "elevated" airport makes use of the force of gravity to assist landing and take-off (Fig. 3). Here the main source of income for investors is a massive skyscraper which houses, in addition to the usual airport accommodation with hangarage and repair shops, a wide variety of industries, offices, shops, flats, theatres, restaurants, etc., all providing rental to the enterprising financiers. Modern soundproofing methods eliminate unwanted noises. Occupants enjoy the convenience of an "airport on their doorstep."

A shorter landing run is envisaged by virtue of the uphill gradient, coupled with a runway surface (Fig. 4) designed to offer resistance to travelling uphill while permitting rapid acceleration downhill for take-off. The height of the elevated aerodrome gives an added advantage when the surface-wind velocity is appreciable. At, say, 500ft pilots can count on an extra 10-20 kt which will again assist take-off and help to slow up the aircraft at touch-down. Passengers are embarked under cover in the airport building, travelling up to the top platform in lifts. Similarly, arrivals taxi into the lifts and are taken below for unloading.

The "elevated" design, like that of the "circular," makes good use of the available land space, and, if high enough, need only cover about 200 acres.

No doubt other ideas will be forthcoming in the search for an answer. One thing is certain, for many years to come the conventional aeroplane will hold the field. Speeds will continue to increase, and so will landing and take-off speeds. Existing runways will not be able to cope, and it is well that some thought is being given to finding the answer. Perhaps the aviation vocabulary will soon include CTOL—"circular take-off and landing"—and/or GATOL—"gravity-assisted take-off and landing."

H. TEMPEST

Leaves from a Line-book

On the Tarmac in the Twenties (when Life was not so Grim and Earnest)

MOST readers know the classic anecdotes of the golden days of aviation between the wars . . . the instructor who threw away his control column . . . the V.I.P. who stepped overboard from the flying-boat. Here are some others, hitherto unpublished (as far as we know) and guaranteed genuine by their author, who today holds a senior technical post with a leading firm of aircraft constructors.

THE Avro 504K was diving steeply earthwards. To the airmen on the tarmac it appeared that a crash was inevitable, but with minimum height to spare it zoomed, levelled off just before the stall and continued an erratic course across the aerodrome. The flight commander danced with rage, muttering in his native French awful imprecations which foretold dire penalties for the pupil—if he survived—who had taken up an aeroplane without authority and without ever before having flown solo.

The time was the mid-1920s and the place No. 5 Flying Training School, Sealand. The "pupil" was, in fact, a young flying-officer instructor who loved to play practical jokes on his seniors. On this particular occasion a fresh batch of pupils had just arrived and been kitted-out with flying clothing. "Borrowing" brand-new Sidcot, helmet, goggles and gauntlets, the practical joker had arranged with his colleagues to notify the flight commander that one of the new boys had taken off on his own.

The Avro made a shaky turn, slid around the end of a hangar and dropped on the grass with a thud which must have taxed the rubber cords of the undercarriage to their limit. Before it had rolled to a halt the flight commander was running out to order the pupil from the cockpit. Just as he was level with the tail a burst of engine temporarily halted him and blew away his cap. Without waiting to recover it he resumed the pursuit, but the apparently flustered occupant kept "blipping" the engine and the exhausted runner finally gave up the chase as the engine was opened up to full revs. The aircraft took off, gained some altitude, then turned and dived at the now retreating figure. As it climbed away on a steady course and the angry flight lieutenant returned officewards a crowd of grinning erks on the tarmac diplomatically disappeared . . .

Did someone who witnessed this, I wonder, later introduce the version which became a popular feature in the repertoire of every air circus in the 1930s and has so often been repeated at flying displays right up to the present day?

The practical joker must be nameless, for he is now a Very Senior Staff Officer; but his pranks outshone any ever thought-up by the high-spirited pilot-officer pupils, whose scope in this direction rather tended to be stifled by discipline.

One foggy winter's day when the aircraft were all in the hangars and the office stoves were roaring away this same instructor was seen walking along the flat annexe roof, carrying sods borrowed from a garden-making exercise and placing one on each chimney-top in turn. A few weeks later he developed a variation of this theme by introducing giant squibs through the outside flue-doors. They certainly dislodged the soot—most of it into the offices!

It was not surprising, therefore, that the practical joking habit spread. A sergeant-pilot instructor who later became a well-known test pilot took his ticket and got a job barnstorming with a joy-riding concern. When they later visited the district he looked up his old pals in the mess one evening and was subjected to a good deal of ribbing on the score that he was "robbing the public." "Damn shame," they told him, "taking ten bob off them and only doing a five-minute flip."

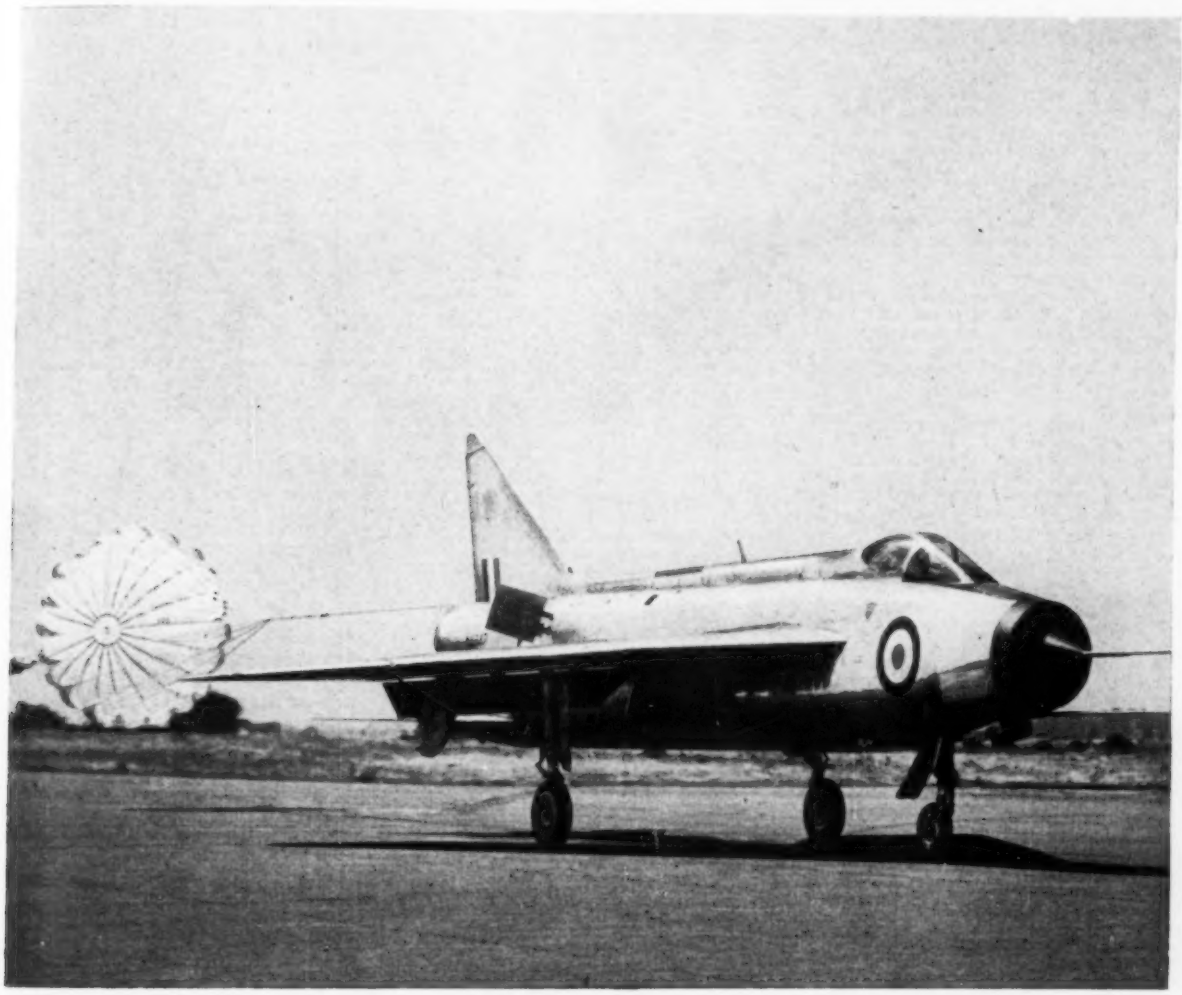
His critics found out the registration letters of the aircraft which he flew and next day two of them formated on him when he was airborne, forcing him into a wide circuit and providing the lucky passengers with a fifteen-minute ride.

Don't let it be assumed from the foregoing that the station at that time was staffed by playboys. Those same instructors turned out a considerable number of pupils who later achieved distinction in all spheres of aviation, while some of the instructors themselves are by no means unknown today.

There was, for instance, a young flying officer, reserved in manner, whose crazy flying had to be seen to be believed. He is now Air Marshal Sir Thomas Pike, C.B., C.B.E., D.F.C. Then there was F/O. the Earl of Bandon now Air Marshal, C.B., C.V.O., D.S.O. And among the N.C.O. pilots there was F/Sgt. Sparkes, whose development work in sustained inverted flying contributed largely to the successful inverted formations which became a feature of the pre-war R.A.F. Displays at Hendon. His hobby was motor cycling, and seldom was he seen without his brown spaniel riding with him on a cushion strapped to the tank. He competed in reliability trials with such consistent success that he was given special leave to ride a manufacturer's new model on a world tour.

Another instructor, F/L. J. A. Mollison, had still to come to fame as a pioneer of long-distance flights, but his dead-stick landings were a by-word. In a Bristol Fighter at about 1,500ft over the aerodrome he would switch off the engine and ease up the nose until the propeller stopped turning; then, descending in a series of side-slips, he would make a three-point landing on the grass, always so perfectly judged that the "Biff," with only the drag of the tailskid to bring it to a halt, would just roll to the edge of the tarmac.

Taking a new mechanic out on a morning test, another expert



WHAT LENGTH OF RUNWAY DOES THE P.1. NEED

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LEAVES FROM A LINE-BOOK . . .

of the same era was apt to taxi his aircraft to the far side of the aerodrome, point it directly at a hangar, and open up; then, levelling-off at 20ft above the grass, he would hold the control column between his knees and use both hands to make leisurely adjustments of his goggles for the benefit of the quaking passenger in the back seat. The jest was rounded-off by a last-moment zoom over the hangar roof.

"Climbing the hangar walls," as this manœuvre came to be known, was doubtless foolhardy and bad for flying discipline, too; but this sort of lark by instructors appeared to be viewed with a more tolerant eye than it would today. Aeroplanes, it may be remembered, were less expensive in those days.

Of course, there were crashes; but quite often they were accompanied by an air of comedy rather than of tragedy: like that which happened with a "Nine Ack" flown-in by an A.O.C. on a visit of inspection. Failing to notice a slender wireless mast, he struck it with one wing-tip, swinging the aircraft off its glide-path so that it came to rest perched precariously on the corner of a hangar roof. Damage amounted to one dented leading-edge and a broken propeller and undercarriage. The A.O.C. and his passenger eventually set foot on earth after ladders had been procured and placed in position—an operation which involved some delay to the two "high-ups" (in every sense of the word) stranded on the roof. And there was an anti-climax. Salvaging an aircraft from this position was an operation not covered by any manuals, and attempts to remove the engine by means of improvised sheer-legs led to the precarious balance being upset, so that the aircraft fell on to the concrete below. Result: write-off.

There was another amusing incident involving a senior officer paying a flying visit. Those readers who knew Sealand will recall that a railway line divided the station into two almost equal halves, one of which housed the Flying Training School and the other a packing depot. Aircraft destined for the Middle and Far East were flown to the packing depot, dismantled and packed into crates, which were then shipped from Birkenhead, a few miles away.

The senior officer arrived unannounced, but a staff car was promptly summoned to take him to the mess.

When he returned to the tarmac some two hours later, with the C.O. to see him off, there stood his personal aircraft—minus wings, which were already on their way into a packing case. By a coincidence, an aircraft of the same type had been signalled in for packing but had not up to then arrived. Never had a set of mainplanes been reassembled and re-rigged in such a short space of time!

It must be admitted that the discomfiture of one's fellow-creatures often provides a laugh. There was a really big one when an unfortunate Air Ministry expert examining the wreckage of an aeroplane from which the occupant had escaped practically unscathed was accidentally hit on the head and taken to hospital suffering from concussion.

It happened thus. A pupil flying solo in a 504K got into a slow spin from which he failed to recover. The aircraft struck a hangar roof, the engine making a hole through which the fuselage followed, mainplanes, undercarriage and tail unit being left behind. The fuselage fell on to a wing standing on trestles, which collapsed under the onslaught, and the pilot was helped out of the tangle of wood, wires and fabric suffering nothing more than a cut forehead, though extremely puzzled to know where the rest of his aeroplane was. It was a day or two later, when the investigation into the cause of the accident was under way, that a sizeable piece of rafter, which had been suspended by a few fibres, suddenly parted company from the roof and landed on to the head of the expert, with the consequence related above.

Finally, the story of a Sopwith Snipe and a Punctured Pupil. He was doing a cross-country exercise when an engine failure demanded a forced landing. He put down in a grass field which had not as good a surface as appeared from the air. The aeroplane finished up on its back, but the occupant emerged unhurt and went off to report by telephone to his flight commander. Returning to the scene of the accident he found a few curious bystanders being marshalled by the nearby village policeman, a stolid North Country type complete with bicycle. When the crowd of half-a-dozen or so were under control out came the inevitable notebook and particulars were entered. Supplying details, the young pilot officer (who happened to have rather an affected voice) said:

"I was tooling along nicely when suddenly the jolly old engine expired, so I stuffed down the nose and headed for this field. Made a lovely three-pointer then whoops! and I was over on my back; think I must have hit a rut."

The puzzled look with which this statement was received gave way to one of incredulity.

"Get off with yer," said the bobby, "might 'a bin a rabbit or a 'are but a rat wouldn't overturn no flyin' machine!"

JAYSEE

AVRO AIRCRAFT APPOINTMENT

APPOINTED executive vice-president and general manager of Avro Aircraft, Ltd., Mr. J. L. Plant comes to the company from an executive vice-presidency at Collins Radio Co. and after flying and administrative service in the R.C.A.F., from which he retired with the rank of air vice-marshal. His last post was as A.O.C. Air Materiel Command and he had previously been Deputy Chief of Staff, Logistics, at AAFCE, and in 1953 Chief of Staff there.

Mr. Plant's appointment follows Avro Aircraft's recent "realignment of management responsibilities" (referred to in *Flight* for November 29).

SHOWROOM COMES HOME

THE Anson 19 used by Lec Refrigeration, Ltd., as a flying showroom has returned to the company's headquarters at Bognor Regis after a successful first overseas tour of 15,000 miles, during which several European countries and over 20 territories in North, Central, East and West Africa were visited. The aircraft was flown by Mr. George Farley with Mrs. Jackie Moggridge as co-pilot.

FIREPROOF FABRIC

ONE of the most important aspects of fireproofing aircraft cabin interiors concerns materials used for upholstery and curtains. A firm that has given the matter considerable thought, and with a background of practical knowledge, is Baynes Aircraft Interiors, Ltd., Langley Aerodrome, Bucks. They have recently produced a fireproof cloth with some attractive qualities.

Sold under the trade name of "Bayette," it is a synthetic material the composition of which has not been divulged. As it is inherently flameproof no additives or proofing processes are required; therefore, states the company, its properties do not deteriorate after repeated cleaning.

With a "feel" rather like that of a good-quality domestic upholstery material, "Bayette" can be produced in any colour, design or weight, and costs about the same as an all-wool cloth of similar weight. A sample tested by *Flight* charred rapidly when exposed to a petrol-lighter flame but did not support combustion: the charring ceased instantly when the flame was removed. Production is at present on a limited scale, but larger supplies are to be available in the near future.

PATHFINDER GATHERING

ALWAYS a popular occasion, the Pathfinders' Ball this year attracted some 600 people to the Dorchester Hotel, London, on December 7—for the fifteenth occasion. Guests of honour were Air Chief Marshal Sir Frederick Bowhill, Air Chief Marshal Sir John Baker, and Sir James Barnes. And, of course, A. V-M. D. C. T. Bennett and Dr. J. C. MacGown were at their usual table.

Christmas pudding aflame, the choristers of St. Paul's and St. Mark's for carols, and a cheerful floorshow added to the evening's entertainment. Alex Thorne, now a partner of Birks-Thorne, once again undertook the direction of the ball, with Johnnie Johnson, Peter Swan and Don Nelson to help with the organization.

COMPUTER AIDS HELICOPTER DESIGN

A METHOD of using digital computers as a means of solving helicopter design problems related to performance and handling was described by Mr. J. M. Harrison, A.F.R.Ae.S., of Westland Aircraft, Ltd., at a meeting of the Helicopter Association held in London on December 6. The computer used was the IBM 650, employing the standard Hollerith punched-card system. It had proved to be particularly easy to programme and so could be handled by the helicopter engineers themselves with little vetting from the computer specialists. Two simulated flight conditions were chosen by the lecturer to outline the method; the take-off and the autorotative landing. The investigations so far completed had shown the system to be remarkably efficient in practice and provided answers to problems with astonishing speed. There was a great future potential for extending the use of the system to enable many design problems, including stability, to be investigated.

THE INDUSTRY

Folland Apprentices Rewarded

THE annual prize-giving at Folland Aircraft, Ltd., Hamble, on December 4, was attended this year by A. V-M. Sir Denis H. F. Barnett. Welcoming him, Mr. W. E. W. Petter (managing director and chief engineer) reminded those present that Sir Denis was Commander of the Allied Air Forces during the Suez campaign. Commenting on the current policy of rationalizing the aircraft industry by re-forming it into larger groups, Mr. Petter said that Folland Aircraft were already pursuing the rational policy of concentrating on a product suited to the resources of the company.

Left to right: Mr. J. Keiser, Air Marshal Sir Denis Barnett, John Nineham.

Mr. Keiser, the company's education officer, then reported on the year's activities. The intake of apprentices had been reduced during the past year, and this had made it possible to raise the standard of training offered to those accepted.

Before presenting the prizes, Sir Denis Barnett made a brief speech in which he remarked on the favourable impression he had formed during a tour of the works.

The prize for the outstanding apprentice was won by John Nineham, an engineering apprentice.

Mr. D. B. Smith, assistant chief engineer, thanked Sir Denis for attending; and a few words by John Nineham, speaking on behalf of the apprentices, concluded the proceedings.

Continuity and Insulation Testing

AUTOMATION in the repetitive inspection of aircraft and other electrical equipment is exemplified in a new test unit produced by M.L. Aviation Co., Ltd., of White Waltham, Berks. The equipment is an automatic comparator which will accept or reject from measured values within definite tolerances, but its novelty lies in the ability to perform, automatically and simultaneously, all the usual types of electrical tests, while it steps through, in succession, fifty electrical circuits. A fault in any of the circuits causes the stepping mechanism to lock and a lamp to be illuminated to indicate the nature of the fault; and the circuit in which it occurs is also immediately identified.

It is stated that the tester has been applied in M.L. Aviation's own factory in speeding-up production checking of aircraft cable harnesses, electrical testing time being cut to less than 10 per cent of that previously required. On this work the device tests continuity and line resistance of the separate cores in multi-core cables;

Mr. C. G. Erlam, recently appointed general manager of Palmer Aero Products, Ltd., has now joined the company's Board of directors. Mr. Erlam started his career with de Havilland Aircraft Co., Ltd., in 1929 and joined Saunders-Roe, Ltd., in 1935. From 1940 he was with Airspeed, Ltd., for ten years. He then accepted an appointment with Chrysler (Australia), Ltd., and in 1956 returned to England to work for Edgar Percival Aircraft, Ltd., leaving them to accept the post of general manager of the Palmer company.

The new M.L. test unit (described here) in use for a 50-circuit test on a junction box. On the left of the panel is the identification matrix, and on the right is the fault indicator.

checks the leakage resistance; and tests resistance to flashover between each individual core and the others. At the same time, the physical length of the harness connector is checked by relating the length to the line resistance.

The unit is not, of course, restricted to testing cable harnesses or connectors; provision of a 4 kc/s oscillator enables reactance, either capacitive or inductive, to be checked similarly. Tests can all be applied simultaneously, or a selected particular test or group of tests can be applied to a selected circuit or component as programmed by a preselector. This is set up beforehand with appropriate links so that the value of the particular property being checked is compared with a standard. The tolerance value within which the tester will "pass" or "reject" is adjusted as required by varying the overall response of the unit.

The tester is based on the principle of automatically balanced bridge circuits which are stepped off in sequence when the unit is operating. One arm of the bridge is the unit or circuit under test while the corresponding opposite arm is a standard component of correct comparative value mounted in a separate preselector box plugged into the test panel. Since the bridge uses a null point to indicate correct balance, an erroneous result might be obtained owing to a fault in the equipment. To avoid this risk the bridge is deliberately pulled off-balance at the start of the test; the circuit or component to be tested is then inserted automatically and, if all is well, the bridge will balance.

In its present form the unit is designed to test circuit resistance; physical cable length; insulation resistance up to 100 megohms at 500 V; D.C. flashover at 2,000 V; and impedance as required (resistance, capacitive reactance or inductive reactance); and it will check up to fifty circuits or components a time in quick succession. The present unit will operate on 200-250 V from A.C. mains.

IN BRIEF

To handle their growing interests in Scotland, Power Auxiliaries, Ltd., one of the Plessey Group, have appointed Mr. D. G. Balfour-Ogilvy, of 111, Milngavie Road, Bearsden, Glasgow, as their representative for the Glasgow area.

* * *

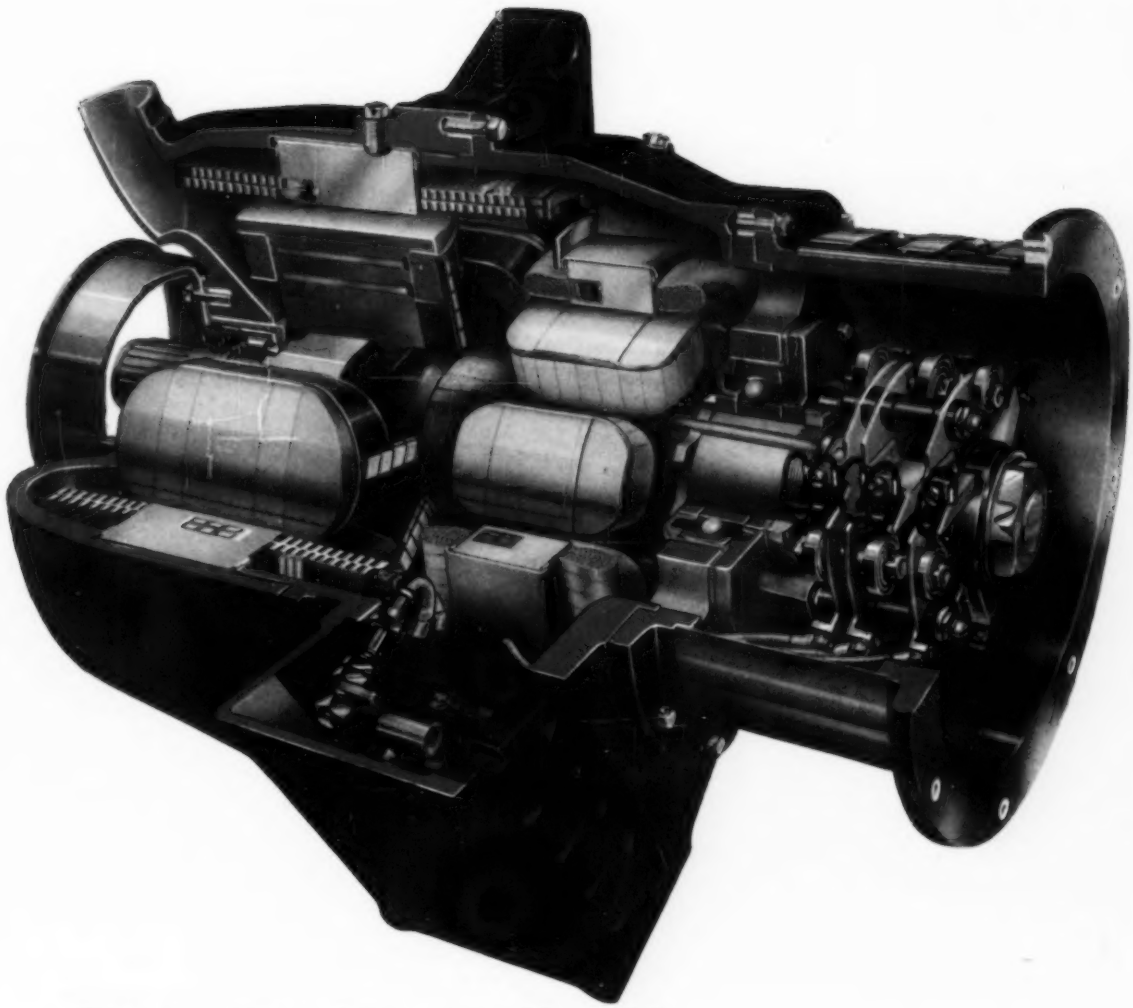
Purchase of the entire share capital of the Rotameter Manufacturing Co., Ltd., has been completed by the Elliott-Automation Co., Ltd. Rotameter, Ltd., who are manufacturers of variable-area flowmeters and density meters, will remain under Mr. H. R. Trost and Mr. A. H. Trost as joint managing directors and Mr. F. C. Whalen as technical director, and business will continue at the company's Croydon works.

* * *

A device to detect and measure water in gas-turbine fuel has been developed at the Wayne Kerr Laboratories in Tolworth, Surrey. The instrument is used to measure the water content before the fuel is transferred to the aircraft, and also checks it in flight, switching on the tank de-icing system when necessary. It utilizes a dipping electrode in conjunction with an electronic measuring device, and can detect, state the makers, 0.0005 per cent of water in fuel.

* * *

An agreement has been signed whereby the Pyrene Co., Ltd., of Brentford, Middlesex, have acquired additional trademarks, patents, sales and manufacturing rights hitherto owned by the American Pyrene Company. The negotiations, which were concluded by Mr. Francis Harrison, chairman of the British company, will enable the company to develop an export market in South and Central America and in some European countries, where trading has previously been restricted.



The sky's no limit...

Rotax equipment is above all designed with experience, manufactured with skill and operated with confidence

The rapid progress of British aviation is reflected in the fine performance of Rotax products all over the world under all operating conditions. What better testimonials to our engineering and manufacturing organisation! Extensive developments in electrical equipment underlined the demand for improved generating systems. With vast experience, we naturally set the pace in this field.

The 50 K.V.A. alternator, with a speed range of 6,250 to 11,000 r.p.m., is only one of many designed by Rotax for the world's most advanced aircraft.

The rated output is : 208 volts – 83 amps – 3 phase
104 volts – 71 amps – 3 phase
65 volts – 45 amps – 3 phase

Whatever your need – one unit, or a complete generating system – you can be sure Rotax engineers will meet your specification.

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Lucas-Rotax (Australia) Pty. Ltd., Melbourne & Sydney, Australia.
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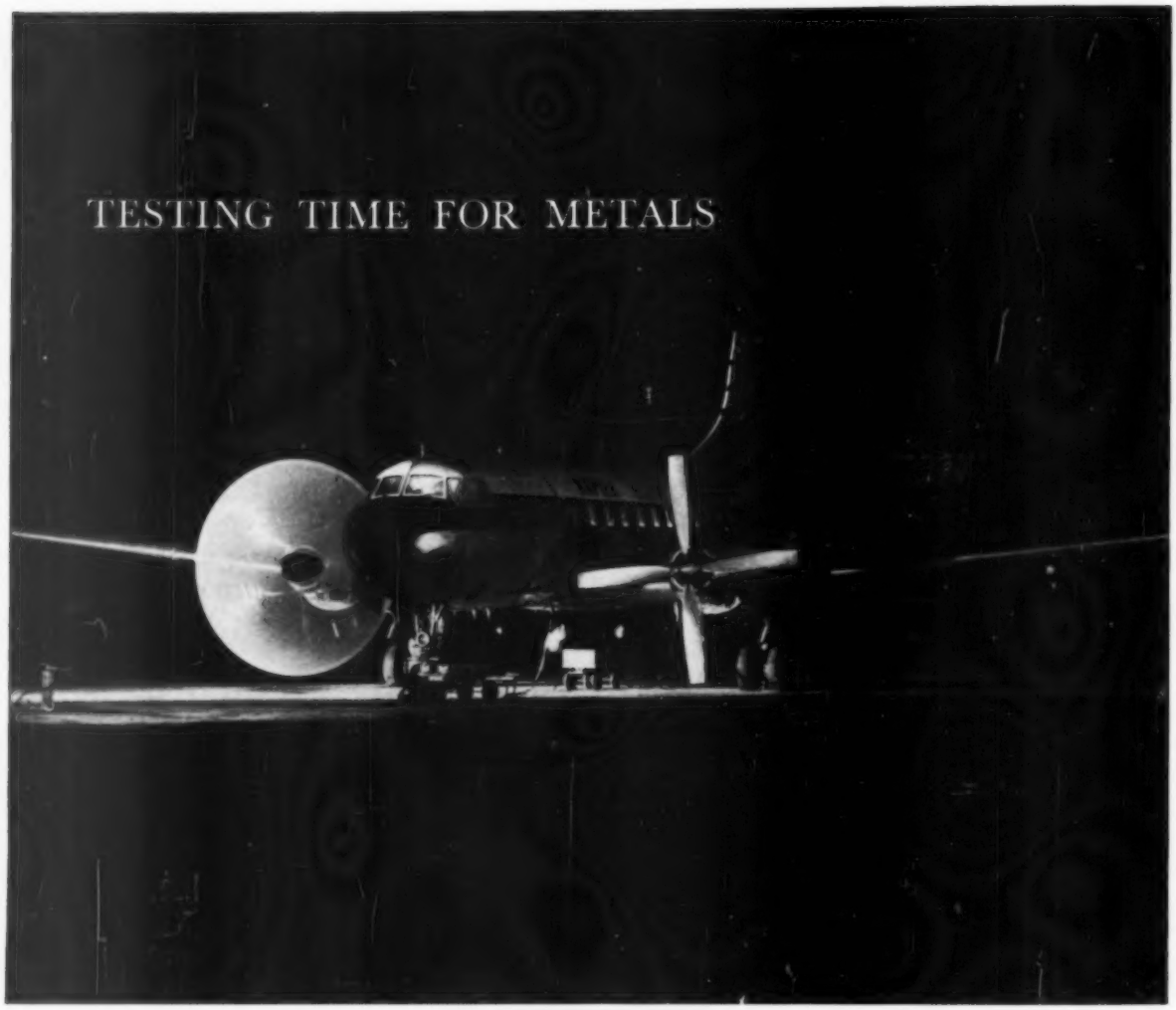
TESTING TIME FOR METALS



Ground-running the starboard turbo-prop of the Napier Eland Convair medium-range airliner.

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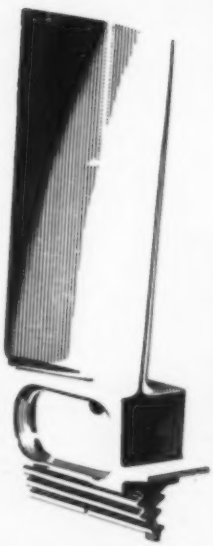

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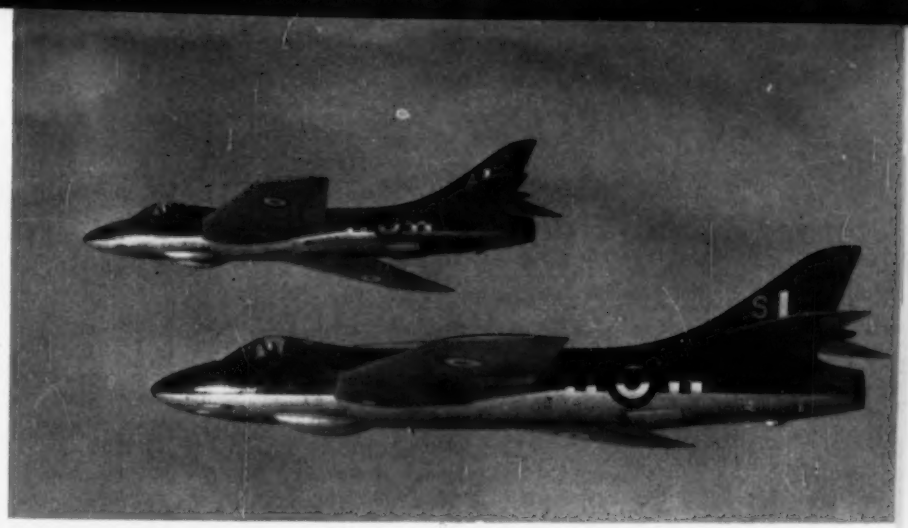

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SERVICE AVIATION

Royal Air Forces and Naval Flying News

Dental Services Director

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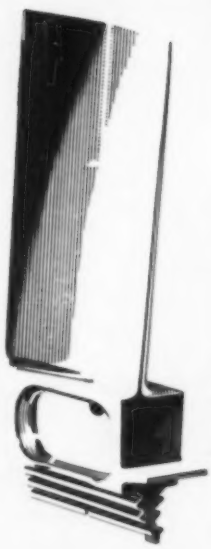

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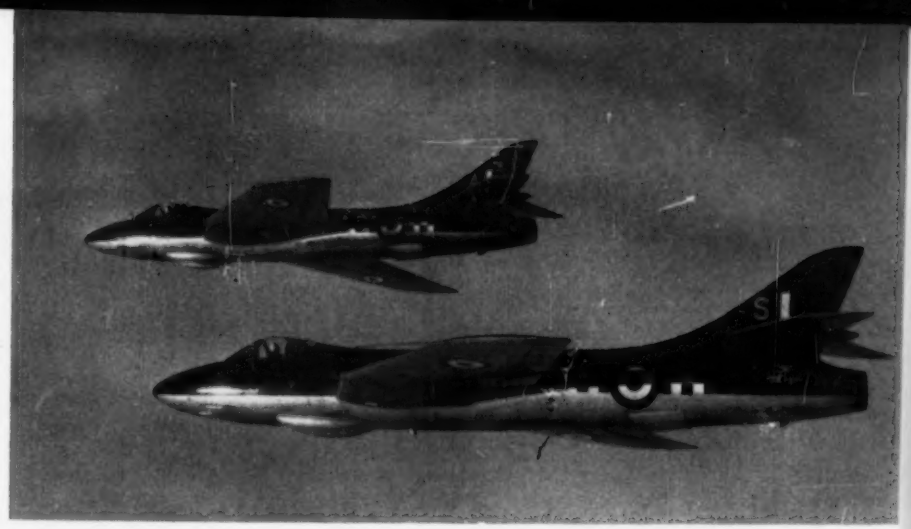

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eventualities. Recently a lady's cat which missed the civilian boat had to be forwarded by stages to Sylt; urgent domestic messages from families to fathers or *vice versa* are passed on; baggage sometimes gets left behind; and "holding the baby" is often a literal task for the unit's members.

Approximately 28,000 people a month pass through the Hook on leave, postings, attachment or courses. This traffic increases at certain times of the year—before Christmas, during the summer, and around Bank Holiday periods. There are three ships in continuous service—*Empire Wansbeck*, *Empire Parkstone* and *Vienna*—and the whole complex operation is controlled by the movements organization of 2nd T.A.F. and the Rhine Army. Military freight (in road-rail containers) also passes through the Hook.

No. 110 M.U.'s share in this traffic means that every other day the unit's members are on duty from 7.45 a.m. until the night's ship has sailed (at 10.30 p.m. or later). This continual overlapping of work into what is normally off-duty time might have an adverse effect on morale but does not seem to have affected the unit, probably because S/L. Walton's energetic cheerfulness has infectious results. "We are here to provide a service," he says. "We can make or mar somebody's arrival in this country. They may ask you a question that is outside your terms of reference; you've got to use your nous." One of his n.c.o.s, F/Sgt. Dickson, expresses the general attitude in this way: "If a man is a good man, do something good for him; if he's a poor one, try to help him."

This spirit permeates the unit and one is glad to acknowledge the service it gives. It would be pleasant to report that its members were housed comfortably enough to offset long hours on the cold dockside. Unfortunately they are not, most of their accommodation being Nissen huts of wartime vintage. Nor do the unit share in 2nd T.A.F.'s allowances or leave facilities, or get concessional rates from the Dutch airlines; and though those of its members with cars must have BZ numberplates, the nearest concessionary petrol pump is 240 km away in Germany.

Nevertheless, the morale of No. 110 Movements Unit is remarkably high; it takes a leading part in Garrison activities and has an excellent record in Command sports competitions, at present holding seven out of nine Garrison cups. Above all, it enjoys its work of looking after Service personnel on their way to and from the Continent and smoothing out those wrinkles which beset all travellers.

SERVICE AVIATION...

A.V-M. A. Earle, A.O.C. No. 13 Group, Fighter Command, presenting the Ingpen Trophy to W/C. J. C. Forbes, C.O. of No. 33 Sqn., at R.A.F. Leeming on Dec. 6. The trophy is awarded annually for the best air gunnery by an all-weather squadron in Fighter Command. No. 33 (formerly No. 264) flies Meteor N.F.12s and 14s.

Airlift Anniversary

RECENTLY the R.C.A.F. celebrated the first anniversary of its airlift operations for the United Nations Emergency Force. These are at present being undertaken by No. 114 Communications Flight, based at Capodichino Airport near Naples and equipped with four C-119s. In a dispatch on its work F/L. Eric McVeity says that the airlift to and from Egypt was originally provided by No. 435 Sqn. aided by aircraft and aircrew from No. 436; in December last year, for example, some 83 round trips were made between Italy and Egypt and by the end of it 1,712 passengers and approximately 614,000 lb of freight had been airlifted.

F/L. McViety describes how the early days of the U.N. airlift "had their trying moments," with complicated procedures to be observed in flying over Egypt. Requests for clearance had to be made 18 hours in advance of take-off, while entry was only permitted 30 minutes after local sunrise and departure 30 minutes prior to local sunset—both through a narrow corridor between Rosetta and Abu Suweir. However, since these procedures have been relaxed and the R.C.A.F. base in Egypt moved to El Arish, the aircraft "move about the Sinai with comparative ease."

NATO Range Opened

A NEW NATO air-firing range at Decimomannu in Sardinia was officially opened on December 4 at a ceremony attended by the Canadian Ambassador to Italy, Mr. Pierre Dupuy, by A.V-M. H. B. Godwin, A.O.C. the R.C.A.F. NATO Air Division, and by senior Italian and Canadian officers. The range is due to be used by the air forces of Canada, Italy and (later) West Germany and it has been in operation since June when No. 439 Sqn. flew down to Sardinia from Marville. Subsequently, eight other squadrons from R.C.A.F. bases in France and West Germany have visited the range, the latest there being the first CF-100 squadron—No. 445—which is based at Marville.

College Journals

BOTH the R.A.F. College at Cranwell and the Staff Colleges at Bracknell and Andover have recently published new issues of their journals. *The Hawk*, which is unhooded yearly at Bracknell (5s post free), in addition to its notes on both colleges and their respective Nos. 47 and 15 courses contains articles on major news topics—the Defence White Paper, the future of Communism in the Soviet Union, and the rise of Arab nationalism. The Cranwell journal includes (as a contrast to more serious matter and special news of No. 70 Entry) brisk skits on three national dailies—disguised as the *Daily Retch*, *Daily Shirker* and *The Chimes*—in appropriate formats.

West Kirby Closes

TODAY (December 20) No. 5 School of Recruit Training at R.A.F. West Kirby, Cheshire, is due to hold its final passing-out parade with A.V-M. R. Faville, A.O.C. No. 22 Group, Technical Training Command, as reviewing officer. Seven former C.O.s are attending the station's closing ceremony and amongst the town and county dignitaries invited are the Mayor (Ald. H. Dawson) and Chief Constable (Mr. H. D. Vann) of Birkenhead, to which R.A.F. West Kirby has been affiliated.

No. 5 School of Recruit Training was opened there on April 25, 1940, the first recruits arriving on May 16. During that year West Kirby was used as an assembly point for Polish Air Force Personnel coming to England; the following February recruit training was stopped and the first R.A.F. Personnel Despatch Centre set up for kitting-out airmen and airwomen going overseas; then after the war, in September 1946, West Kirby reverted to its original rôle as a recruit training school. Today the last of 155,000 regular and national service airmen who have been trained there will march off its parade ground.

Apprentice Vacancies

THERE are 500 vacancies for aircraft apprentices in the R.A.F. and 100 for administrative apprentices to train in advanced ground trades. Candidates, aged 15-17, may seek nomination through headmasters, youth employment officers or C.O.s of cadet units and applications should be made (on Form 1391) to Air Ministry, E.S.5(B), Adastral House, Kingsway, London, W.C.1, by January 14.

2nd. T.A.F. Christmas Parties

CHRISTMAS parties for both British and German children are being held at many R.A.F. stations in 2nd T.A.F. Fifty youngsters from two local orphanages are being entertained at Handorf today, December 20; the Royal Antediluvian Order of Buffaloes' No. 8351 (Scorpion) Lodge at Laarbruch is giving a party for 70 British and German children, 20 of them orphans, in the British Forces' primary school; and one of the smallest 2nd T.A.F. units, R.A.F. Iburg, has been saving money for six months to give a party for 50 German children of poor families.

R.A.F. Postings

AMONG appointments recently announced by Air Ministry are the following:—

W/C. W. N. Ash to Air Ministry, for duty in the Department of the Air Member for Supply and Organisation; W/C. K. W. C. Bindloss to SHAPE, for staff duties; W/C. E. L. Frith to H.Q., F.E.A.F., for administrative staff duties; W/C. J. Goodman to H.Q., Home Command, on R.A.A.F. exchange duties; W/C. J. L. Whitford to H.Q., F.E.A.F., for technical and staff duties; Wg/O. I. F. Stone, W.R.A.F., to H.Q., Home Command, for administrative staff duties.

S/L. L. Baume to H.Q., No. 41 Group, for air staff duties (with the acting rank of wing commander); S/L. G. V. Cowmeadow to Air Ministry, for duty in the Department of the C.A.S. (with the acting rank of wing commander); S/L. P. A. S. Thompson to R.A.F. Benson, for administrative duties (with the acting rank of wing commander); S/L. J. B. Yates to R.A.F. Watton, for technical duties (with the acting rank of wing commander).

Congratulations to Fairey

on another splendid achievement

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Goodyear are proud

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to this project

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Praise from all quarters

Admiration FROM AUSTRALIA

Butler Air Transport Ltd., NSW, have been operating Viscount 747s for nearly two years. Mr. A. Butler recently expressed 'his appreciation and admiration of these wonderful aircraft which have brought a standard of travel equal to the world's best, to the outback people we serve'.

Growth IN THE MIDDLE EAST

Middle East Airlines report that 'The operation of Viscounts has enabled M.E.A. to achieve two aims — to build up our regional Middle East Services and to develop from a regional into an intercontinental carrier'. Up to 78% increases in passengers carried were recorded as a result of Viscount introduction, and aircraft utilisations of from 7 to 9½ hours a day were achieved throughout the summer with no serious maintenance problems.

Praise FROM MANILA

'The Vickers Viscount is far ahead of anything I have experienced before' commented an American passenger to Philippine Air Lines. In June, on the Manila Hong-Kong route, the Viscount payload was 89.6% for the outward journey and 89.3% on the return flight.

Satisfaction IN FRANCE

From Air France comes a report of 19% traffic increase during 1956 on the London-Paris route and a 29% increase on the Swiss routes, both served by Viscounts. Particular mention is made of Air France's satisfaction with its share of total traffic on the Viscount-operated Italian and British services.

VICKERS VISCOUNT

FOUR ROLLS-ROYCE DART PROPELLER-TURBINE ENGINES

VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED WEYBRIDGE SURREY

TGA AT558

CIVIL AVIATION

Jets and Shotguns

AT last it seems that a decision about B.E.A.'s new jet airliner is imminent. Few, if any, new British transports have been conceived with such difficulty. The technical, financial, industrial and political issues involved have been delicate in the extreme: many are still unresolved. But the basic decisions have been taken, and the way will soon be clear for the industry to get moving with its second major commercial transport for the nineteen-sixties.

Like B.O.A.C.'s medium-sized VC-10 (which is being privately financed to the tune of £70 million by Vickers and Rolls-Royce), B.E.A.'s new short-range jet will be a private-venture project, to be financed and developed by a consortium of British firms. The design selected by B.E.A., according to unconfirmed reports last week, looks like being the de Havilland D.H.121. The Corporation made its choice during the summer, and has apparently since left it to the industry, the Government and the Treasury to determine the means by which the project will be launched.

The imminence of the B.E.A. order calls for a recapitulation of the issues involved. Of these, the biggest by far is financing. The Government have at length decided that the project shall be a private commercial venture, and it is probable that this decision was to some extent influenced by the Hawker Siddeley Group's offer, last summer, to finance alone the design and development of their Avro 740 jet project. This turn of events evidently required the other main contenders to reconsider their attitude towards Government support. It is possible that Government help would have been forthcoming, but only on Ministerial conditions as to the regrouping and rationalization of the industry. But the firms and the Ministries have strived to avoid shotgun-weddings, preferring voluntary acceptance of the principle of industrial co-operation. It is worth recalling the previously reported words of the Minister of Supply, Mr. Aubrey Jones, for their possible significance in the present context: "It is desirable that the industry should reshape itself into stronger units. I have accordingly intimated to the industry that in placing orders for further requirements the Government will be influenced not only by the quality of design but also by the resources, technical and financial, available to complete the project quickly and successfully; and that, in so far as these criteria are not met in isolation, the Government will require the chosen contractor to work in association with one or more other contractors."

Financing and the apportionment of technical effort have not yet been finally arranged, and may indeed be still at an early stage of negotiation. But it is clear that momentous events are to be enacted within the industry, and the group which emerges, whatever its composition, will not only be technically strong but will also, in the development of B.E.A.'s jet, be its own piper. Independence of the public purse and the risk of private capital—probably about £25 million will be involved in the design, development and tooling of the B.E.A. jet—could well be the surest guarantees of a successful product. The principle of Ministry support of the industry's basic research, which is investment in the nation's future as a technological power, must still hold good; but it seems that in future the bread-and-butter products to which the industry applies its basic research will be private ventures. The Government appear to have handled the B.E.A. jet order in the manner of a catalyst, which cleverly encourages chemical changes while itself remaining passive.

The technical issues involved in the development of the B.E.A. jet have already been fully discussed in *Flight* (see "The Short-Haul Jet Transport," September 6). It now seems that the three-engined layout, using either Rolls-Royce RB.141s (scaled-down Conway by-pass) or Bristol Zephyrs (commercial Olympus 553, also to be built by Curtiss-Wright), will be adopted. It is reported that the value of the B.E.A. order will be £30 million; if this is so, the Corporation is planning on a fleet of about 20 aircraft (curiously, B.E.A. have always ordered their new aircraft in initial batches of 20). B.E.A. have changed their minds about the part which jets will play in their future operations: a fleet of 20 aircraft, and the great traffic capacity it would represent, does not conform with B.E.A.'s past view of the jet transport as a specialized vehicle for particularly competitive routes.

What about the export potential of the aircraft? One has to look at the world airline market—in particular the U.S. domestic and intra-European market—stretching for 10-15 years from 1963-1964, when the aircraft will enter service. Airline reaction to the project at the moment could probably be summed up as: "Yes, we're going to need a jet for our shorter sectors, but we want to get our big jets and medium jets established first." Eighteen months ago, the airlines were saying to medium jet proposals that they first wanted to establish their big jets. Since then three new medium jets—the VC-10, Boeing 720 and Convair 880—have been ordered by six airlines. A pattern is emerging, and this country will now be first off the mark with a project designed to complete that pattern—the short-range jet airliner. J.M.R.

THE INDEPENDENTS DINE

THERE is one occasion each year when representatives of every organization concerned with British air transport are gathered together under one roof. It is the annual dinner of the British Independent Air Transport Association: this year's gathering, at the Dorchester Hotel, London, on December 9, was attended by 280 people, and included guests from the two Corporations, the Ministries, R.A.F. Transport Command, the industry, and the many organizations and associations concerned with British air transport.

There were two speakers—Mr. G. H. Freeman, chairman of B.I.A.T.A., whose annual report was summarized in *Flight* last week; and Mr. Harold Watkinson, Minister of Transport and Civil Aviation.

MR. FREEMAN enlarged on the points made in the annual report. He made a plea for a new Government policy; and he fully endorsed the view of the Air League's special report that this was not an issue between independents and Corporations. It was an international issue, and the aim must be to make British air transport as a whole play a bigger part in future international expansion. He regarded "with apprehension" the vast expansion of R.A.F. Transport Command, believing that the same ends could be achieved by building up the independents.

Addressing himself to the Minister, Mr. Freeman said, "You have long listened to the bleats and moans of this Association, and you have spent many a long hour trying to see what is best for British air transport. I ask you to continue in your search with

A dramatic picture taken shortly after Governor Harriman of New York opened the new terminal at Idlewild. Directly in front of the 11-storey control tower is the Fountain of Liberty; behind is the entrance arch of the arrival building. Space is available for 24 aircraft and parking has been provided for 6,000 cars.

Front and centre sections of the first Vanguard fuselage were joined on December 6. They are here being winched together prior to riveting on the external butt-straps and joining the floor members; the winching trolley arrangements are part of the alignment assembly jib. The flight deck will be added shortly; the tail section is already in place.

First turbine transport on the North Atlantic—the Bristol Britannia 312.

CIVIL AVIATION . . .

your usual tenacity." He went on to urge the creation of "an expert aeronautical authority": the Air Transport Advisory Council was held in the highest regard, but it was limited in its terms of reference.

Mr. Freeman paid a tribute to A.Cdre. G. J. Powell, whose departure from the independent scene through ill-health was a great loss. He welcomed Mr. T. W. Morton as the new chairman. ("We have at long last persuaded him to accept the post.") The retiring chairman concluded with a tribute to Mr. D. F. McIntyre, who had lost his life in the Twin Pioneer crash in Libya on the previous day: "No words of mine could express what you all know about his work in our industry."

MR. HAROLD WATKINSON remarked on the anomaly of his post: he was a passionate believer in private enterprise, but was also responsible for two nationalized Corporations. ("At least, they are *supposed* to be nationalized.") But there were no politics involved in trying to make this country in the air what it had always been on the sea. He deplored the "old British habit of knocking ourselves about in public." He was referring here to the Britannia's troubles, and he said that the solution of the icing problem ("I think we now know how it can be solved") was a fascinating story of technical achievement.

The Minister followed this up with some remarks on general British aircraft policy. The "shopping list" would soon, he hoped, include the new jet for B.E.A.; he agreed with Lord Douglas about the big export potential of this aeroplane. It must, Mr. Watkinson said, be a private venture, and the product of "some sort of association" of the industry.

He thought the turboprop would last "longer than many people think" in medium-haul operations, and he was sure that we were right to back the long-range turboprop—and one that was house-trained, which the big jets were not as yet. The VC-10, he said, would be able to deal with long-haul routes without the need for long runways, and Rolls-Royce and Vickers were committing about £70 million to this project.

On the subject of independents, the Minister thought that Mr. Freeman had put his case "moderately and excellently." He congratulated the independents on their pioneering of new forms of opportunity. Both Corporations knew that his support for their re-equipment "means that they will be able to withstand more competition," and he would always listen to advice that showed ways of British advancement that did not put us at a disadvantage in the world market. "Congratulations on making the best use of the crumbs," concluded Mr. Watkinson, "and good luck in the future."

TRANSATLANTIC TURBOPROP

THE Bristol Britannia, which yesterday was due to become the first turboprop airliner in the world to operate a regular service between Europe and America, can be expected to rule the blue-riband route of international civil aviation at least until the summer of 1959.

The introduction of this new North Atlantic service has a strong commercial as well as historical significance, for this is the first time that scheduled services on this route have been operated by anything other than American aircraft.

There has been no lack of beat-your-neighbour between the first two airlines to introduce the Britannia. Early in December, prominent El Al advertising indicated that the first turboprop transatlantic service would be operated by El Al on December 22. A few days later B.O.A.C. quietly announced that their service would open on December 19, but they kept their timetable under cover until last week. No sooner was it revealed than El Al announced a schedule which cut B.O.A.C.'s time by just over an hour in each direction—but admitted that this ambitious programme could be obtained on only four occasions out of five.

December 19 promised to be a day on which the British aviation industry could look backward with satisfaction—and one on which they could also look forward and speculate on the impact which the Britannia will have on North Atlantic travel.

An idea of the Britannia's appeal can be gauged from inspection of the latest published timetables for non-stop London - New York services. Using the Britannia, B.O.A.C. and El Al—and later C.P.A.—will be able to offer travellers a combination of greatly improved comfort coupled with a reduction of between one and three hours in journey time. At the outset this new B.O.A.C. service will be once-weekly in each direction, flying westwards with the sun every Friday and returning overnight on Sundays. El Al's service is limited initially to the same frequency, with overnight flights leaving London on Sunday evening and returning on Thursday morning.

Until next spring the B.O.A.C. Britannia will cater only for first-class traffic. Then frequency will be stepped up, the number of U.S. destinations will be increased (B.O.A.C. has traffic rights to New York, Boston, Detroit, Chicago and San Francisco), and tourist services will be introduced. Surprisingly, no mention is made of operating a third-class Britannia service with higher-density seating.

The limited extent of these initial services will mean that, as far as this winter's traffic is concerned, only an insignificant volume of custom will be enticed away from B.O.A.C.'s and El Al's slower rivals. But it is not just in these terms that the Britannia's success will be measured. If all goes well, the few hundred thousand American travellers who will be planning their 1958 tour of the Old World early next spring will be very much aware that a remarkable new era of air travel, already experienced with such approval by passengers on Capital Airlines' Viscount services, will now be available for transatlantic crossings.

Substantial evidence of the Britannia's success cannot be expected until March, when the heavy flow of eastbound traffic to Europe starts to gain momentum. Introduction of third-class fares on April 1, 1958, should ensure that the flow will be considerably heavier than before. Announcement of a higher-density Britannia layout can presumably be expected before this time. It would be sad if too great an emphasis on first-class traffic—however justified this might have been in the past—resulted in third-class passengers being denied the advantages of Britannia travel. Not only would this mean that the United Kingdom and Israel shares of the North Atlantic traffic will be lower than they need otherwise be, but a little arithmetic suggests that 90 or more third-class seats will yield more revenue and more profit than the 52 first-class/*de luxe* seats offered on the B.O.A.C. service as it is being operated at present. El Al, by comparison, are offering 90 seats—72 tourist and 18 first-class—with four sleepers.

I.A.T.A. STUDY THE JET AGE

LARGE-SCALE conferences on technical studies of the turbine nineteen-sixties tend to follow a common pattern. A great deal is discussed (much of it having been thrashed out before), problems are aired and ideas reviewed; but the conclusions are almost always indefinite. The most positive results achieved seem to be recommendations for further study by more committees.

Yet it would be unrealistic to expect great strides to be made at any one meeting; introduction of turbine transports on the world's air routes requires improvements in every phase of aircraft operation—traffic control, communications, navigation, airport facilities and weather reporting; and the process of apprising airlines, civil authorities and manufacturers of the jig-saw development pattern of the next few years cannot be accomplished overnight.

Thus, when the tenth I.A.T.A. technical conference, to which 500 delegates were invited, completed its two-week session at Miami last month, much of the representatives' time had been occupied in bringing themselves up to date by exchanging data, debating procedures and allocating priorities for further study. In fact, the conference chairman, Capt. J. W. G. James of B.E.A., described its purpose as an "international coming-together—solely to co-operate and to co-ordinate our efforts."

Airline	El Al	B.O.A.C.	P.A.A.	T.W.A.	El Al	B.O.A.C.	P.A.A.	T.W.A.	El Al	B.O.A.C.	P.A.A.	T.W.A.
	Flight Schedule (local time)				Elapsed Time (hours and minutes)				Estimated block speed (m.p.h.)			
Westbound:												
London ... dep.	2340	1030	2300	2100	10 50	12 00	13 35	14 10	318	287	253	244
New York ... arr.	0530	1730	0735	0610								
Eastbound:												
New York ... dep.	1900	1800	1900	1800	8 30	9 50	10 45	11 05	405	350	320	311
London ... arr.	0830	0850	1045	1005								

Fastest London-New York schedules, winter 1957-58. El Al and B.O.A.C. operate Britannias on these services, and P.A.A. and T.W.A. use DC-7Cs and L-1649s respectively.

"Flight" photographs

At the British Airline Pilots Association annual cocktail party at Londonderry House on December 10 were (l. to r.) Mr. Harold Watkinson, Minister of Transport and Civil Aviation, with Mr. G. d'Erlanger, and Sir George Cribbet, chairman and deputy chairman of B.O.A.C.; Capt. A. S. M. Rendall, B.O.A.C., and Mr. P. Masefield, managing director, Bristol Aircraft Ltd.; Mr. R. N. Jennens, British Aviation Insurance, and Mr. G. H. Freeman, chairman of Transair; and Sir Robert Perkins, Mr. D. Follows and Mr. R. T. Merrifield, respectively vice-president, general secretary and chairman of B.A.L.P.A.

Out of discussions came agreement on several significant points. Ten airlines, for example, decided upon a common kerosine-type fuel with a freezing-point of −50 deg C. This agreement does not constitute an international standard, but was formulated so that economies in storage and supply could be made; it does not affect carriers wishing to use JP4 or other types of fuel. More data on noise levels were demanded, particularly on penalties of weight and power loss that would have to be borne. Operators were interested in the economics of retractable- or fixed-nozzle noise suppressors, and they were also anxious to encourage the development of a "go/no go" acceleration-sensing instrument for take-off acceptance.

While general problems were being studied, separate committees met to discuss navigation aids, communications, meteorology, apron requirement and flight planning. Among the results achieved were suggestions put forward for a Doppler-fed computer to give the pilot continuous steering and present-position information; and the drafting of new specifications for upper-air charts. The committee discussing jet handling and servicing at airport terminals prepared detailed information which will be published by I.A.T.A. The most surprising assumption on which this document was based is that manœuvring of turbine-powered aircraft on the apron should be carried out under the aeroplane's own power —a suggestion that, in conjunction with proposals such as those of American Airlines for their £5m terminal at Idlewild, is likely to cause more than a little inconvenience in the passenger lounge.

BERMUDAN EAGLE

EAGLE AIRWAYS (BERMUDA) have been authorized by the Bermudan Government to fly passengers and freight on scheduled services between Bermuda and New York and Montreal. It is not yet clear whether final C.A.B. authorization has been obtained, but the company announces that once-daily services from New York to Bermuda will begin on May 1 next year. The company will trade under the name of Eagle International, and the agents in the United Kingdom will be Eagle Airways.

After some speculation about the equipment that would be used —it had been suggested that Viscounts relinquished by Capital might be chosen—Eagle say that DC-6Bs or Super Constellations are being considered, although the company is also studying the economics of the Britannia and the Comet 4B. Competition on the route will come from Pan American DC-6Bs and 7Cs, Eastern's Constellations (eventually Electras) and B.O.A.C.'s Viscounts. The eventual frequency of Eagle's services could be up to 28 flights a week.

LUFTHANSA PUSHES FORWARD

LUFTHANSA'S latest accounts for 1956 cover the first full year of operation and tell a tale of booming growth. Traffic revenue reached Dm81 million (£7m), over three times the 1955 figure. Route network also trebled, rising to 27,000 miles.

The effects of inflation—average salaries rose by 15 per cent and hourly wages by 10 per cent—were counterbalanced by a reduction in development costs, together with increasing efficiency (average daily utilization increased from 4.5 to 6.0 hours, with Super Constellations exceeding 8 hours). Operating costs fell from over 50d per C.T.M. to 40d—equivalent to those achieved by B.O.A.C. But load-factor at 46 per cent, although well above 36 per cent experienced in 1955, is still insufficient to avoid a deficit of Dm19 million. At present cost and revenue rates, the need for subsidy will vanish when load-factor climbs to 60 per cent. As the first half of 1957 returned a load-factor of over 50 per cent, it appears that Lufthansa should be free of subsidy within the next year or two.

BREVITIES

IN addition to promoting amalgamations in the aircraft industry, the Government has now announced its desire to see a reduction in the number of independent airlines. Lord Mancroft recently stated in the Lords that there are at present "too many for the most efficient operation."

* * *

The British Travel and Holidays Association have recorded an increase from 240,000 to 246,000 in passenger traffic from the U.S. in 1957.

* * *

Mr. J. H. Carmichael (chairman of Capital Airlines), Mr. David H. Baker (president) and Mr. R. G. Lochiel (vice-president and treasurer) have visited Great Britain to discuss the possibility of extending payments on their Viscount fleet. The present arrangements are for monthly cash payments over a five-year period.

* * *

In the new terminal building at Idlewild B.O.A.C. will have the largest facilities of any foreign airline.

* * *

Silver City Northern Division will start a new passenger service between Blackpool and Belfast on May 23. Herons will be used, and the service will initially be flown on Fridays, Saturdays and Sundays.

* * *

The evacuation of Dutch citizens from Indonesia, ordered by that country's government, apparently does not apply to specialists employed on contract to organizations such as Garuda Indonesian Airways.

* * *

Mr. Tom Shand, N.Z. Minister of Civil Aviation, said in Auckland on December 10 that fatigue in the starboard wing had caused the accident to a Straits Air Freight Express Bristol 170 at Christchurch on November 21. As a result, all Bristol Freighters owned and operated in New Zealand would have the safe life of their wing spars reduced from 10,400 hr to 3,500 hr "as a precautionary measure," until the cause of the failure—which took place after 8,000 hr—had been discovered.

* * *

Over 39,000 student pilot's certificates were issued by the C.A.A. in the first half of 1957. Private pilot's certificates totalled 12,134, commercial pilot's certificates 16,479 and airline transport certificates 2,643.

* * *

A basic payment of about £157 per week plus two cents per mile flown is being offered to American Airlines' pilots flying jet transports.

* * *

A new Paris air terminal on the Quai d'Orsay is to be started next year. It has been designed to have a capacity of 10m passengers a year by 1975 and it will be connected with Orly by electric train service with a journey time of 18 minutes.

* * *

T.A.P., "in view of technical difficulties which cannot be overcome at present," are operating a chartered K.L.M. Super Constellation on the weekly service between Portugal, Angola and Mozambique.

* * *

The first production Caravelle is expected to fly "in the first quarter" of 1958. General assembly is complete, and one engine, hydraulic and electric systems, instruments and test equipment have been installed. (A pilot's impressions of one of the two prototypes appear on pages 944-45 of this issue.)

* * *

The flow of second-hand aircraft from North to South America continues. VARIG has purchased PanAm's five remaining CV-240s, together with P.A.A.'s entire stock of CV-240 spares. Another Brazilian carrier, Cruzeiro do Sul, is shortly to take delivery of ten CV-240s from American Airlines.

CORRESPONDENCE

The Editor of "Flight" is not necessarily in agreement wi th the views expressed by correspondents in these columns; the names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

Restrictions on the Private Pilot

I AM very pleased that someone has at last risen to the defence of the much-maligned M.T.C.A. air traffic control officers.

From unnerving personal experience as a controller at an airfield—privately owned—that was used by airline and private aircraft ("Why is your hair so white, daddy?"), I would even go so far as to suggest that no aircraft that is unable to maintain two-way R/T. contact with A.T.C. should be allowed to use any airfield from which scheduled passenger services are operated, except, of course, in dire emergency. Non-radio aircraft can be an absolute menace. To quote a few post-"incident" explanations:—

(1) "I didn't see any reds."

(2) Having just missed landing on a 6ft-deep trench on a closed strip (Yes, it was in *Notams*): "*I* didn't see any white crosses."

(3) Having landed downwind against the "T" and a Rapide on short finals: "There wasn't much wind so I didn't think it mattered." [This was followed by the well-known quote (1).]

(4) Having cut in front of a Dakota and caused same to overshoot: "I didn't see it."

Private aircraft with R/T., *and flown by people who know how to use R/T.*, are an asset to aviation, and aircraft without R/T. are also an asset to aviation, but only in their own backyards at airfields such as Elstree, Fairoaks, Barton, Panshanger, and so on where the eagle-eyed C.F.I. is constantly at hand to see that sloppy flying does not go unpunished, and where the circuit is not cluttered up with large aeroplanes full of fare-paying passengers and mysterious sets of dials, knobs, meters, and black boxes called radio aids.

Private flying in America is thriving partly because aircraft owners are radio-conscious and the authorities are happy to allow *any* aircraft to use *any* major airfield provided that aircraft can be properly controlled. With such a crowded airspace as that of the U.K. regulations designed to protect the people that buy airline tickets must be rigidly enforced, and anyone that criticizes these regulations is only showing his ignorance.

London, W.4. J. M. WILDE.

THE letter from "Airline Pilot" appearing in your November 29 issue reveals that here is just one more man who fails to realize the difference between the two entirely separate professions of instructing and commercial flying.

Whilst we must all agree that there are many private pilots whose standards of flying and knowledge of the regulations are far below standard, and whilst at the same time we must attach much of the blame for this on poor basic instruction, there can be no cause whatsoever to say that this is due to the instructors concerned not holding Commercial Licences. The professional licences in themselves are of purely academic value, and the standard of *pure flying* required is considerably lower than that needed for even an Assistant Instructor's Rating.

The basic handling test for the Commercial Licence is little harder than that laid down for the P.P.L., and, in common with all the professional tickets (for which there is no further test of flying ability at all), can be passed without the candidate undergoing a serious training course of any description! On the other hand, even an assistant instructor, whose privileges are rightly restricted, requires the same 100 hours solo and then completes an approved instructor's course before taking a comprehensive test with an authorized examiner. Even then, he is allowed to instruct (under supervision) only on the type on which the test was conducted, and if he wishes to be "passed out" to give tuition on other machines he must show his ability in all normal manœuvres once again. How different this is from the CA 528 check, where any commercial pilot (not necessarily even a flying instructor) may run his friend round the circuit a few times and sign him as being proficient to operate the type professionally!

The basis of good instructing is the ability to fly accurately, coupled with a good sense of airmanship and discipline and the ability to impart knowledge concisely. Give me a man with a P.P.L. and a couple of thousand hours' basic instructing rather than a raw recruit with a Commercial Licence and 200 hours' total time. Our first friend would know how to analyse his student's faults and knock him into shape from pure experience (and from the background of a sound instructor's course), whereas our second man, with a headful of newly-learnt Notams, Information Circulars, Flight Planning Charts and Performance Schedules, would be groping round the sky trying to discover what this flying game is all about!

The real solution, of course, is to separate the two qualifications entirely. Instead of being able to have an Assistant Rating on an A.L.T.P., a Full Rating on a P.P.L. and so on, we should have an Instructor's Licence or a graduated series of Instructors' Licences. For these the all-important flying side (and remember our man is primarily a flying and not a ground instructor) could be coupled with a reasonable working knowledge of the technical subjects involved, with particular emphasis on such peculiarities of the profession as pre- and post-flight briefings, instructional technique, the student's outlook and so on, and fairly general examinations in aviation law, navigation and meteorology.

If we really must pretend that a man would be better at his job if he acquired a qualification not related to his duties, then let us be even a little more fatuous by suggesting that an airline pilot should be required to hold an Instructor's Rating. Admittedly, if he were compelled to brush-up his basic flying and airmanship and acquire a consideration for other users of the sky by taking an instructor's course (and what an eye-opener this would be for those of us approved for the purpose), then perhaps I would not have to take action to avoid an illicitly positioned DC-6 on the downwind leg of my home circuit, or calm the nerves of a frightened student who on his second solo (and I witnessed this) met a Stratocruiser also in the circuit at 800ft when later investigation proved that it was cleared down to 2,500!

No, Mr. Airline Pilot, we admit that there are some sub-standard flying instructors in circulation and most of them hold Commercial Licences, but how about re-inforcing the glass walls of your own house before trying to drop bricks into other people's property?

Elstree, Herts. DAVID F. OGILVY,
Manager and Chief Instructor, Elstree Aerodrome.

"The First Cabin"

AS a comparatively young historian, Mr. Gibbs-Smith (November 29) is on dangerous ground when he refers to certain reports as "spoof." Such remarks suggest that there may be some truth in "all history is bunk."

Filton, Bristol. A. CADMAN CLINTON.

Norway's Sopwith Babies

MAY a keen supporter of Mr. Bruce's interesting series add a little information about the length of service of the Norwegian Sopwith Babies? Earlier this year, when reading Odd Arnesen's *Polar Adventure*, I made a note that two Babies of the Norwegian Naval Air Service took part in the search for Nobile's airship *Italia* in 1928. The pilot of one of them was Lt. Lambrechts, and they were transported north by the cruiser *Tordenskjold*.

Dorchester, Dorset. JEAN P. ALEXANDER.

Underneath the Arches

REFERRING to Mr. E. C. D. Malone's letter (December 5) concerning flying underneath the aqueduct at Shoreham during the 1914-18 war and Mr. J. M. Bruce's "Historic Military Aircraft No. 17" in particular, the following may be of interest.

On reading *Thrilling Flights*, edited by Capt. W. E. Johns, I find that a certain Lt. V. D. Grant, R.N.A.S. and R.A.F. (Retd.), while stationed at Dundee Air Station, flew a Sopwith Schneider seaplane N.1063 (130 h.p. Clerget rotary) under one of the arches of the Tay Bridge. Then, waving gaily to his commanding officer, Major Wilberforce, he pranged his aircraft on a drainpipe while flying two feet above the shingle!

Birmingham, 14. MAURICE AUSTIN.

FORTHCOMING EVENTS

Dec. 21. Lasham Gliding Centre: Christmas Party.
Dec. 21. Elstree Flying Club: Christmas Party.
Dec. 31. Kronfeld Club: New Year's Party.
Jan. 1. Kronfeld Club: "Radio Observation of Russian Satellites," by G. Whitfield.
Jan. 2. R.Ae.S.: Young People's Lecture, by A. W. Bedford, A.F.C. A.R.Ae.S.
Jan. 4. British Interplanetary Society: "High Altitude Research During the International Geophysical Year," by Dr. R. F. L. Boyd.
Jan. 8. Kronfeld Club: "On the Yorkshire Gliding Club," with films by J. C. Riddell.
Jan. 10. Helicopter Association: "Boost Systems for Helicopter Gas Turbines," by A. W. Morley, Ph.D., A.F.R.Ae.S.
Jan. 15. R.Ae.S.: Main Lecture at Leicester: "Rolls-Royce Engines," by A. A. Lombard, F.R.Ae.S.

R.Ae.S. Lectures (to Jan. 15):—
Dec. 20, *Weybridge*, Annual Dance. Jan. 7, *London Airport*, "Airline Operational Flying," by Capt. W. Baillie. Jan. 8, *Bristol*, "Fail Safe Structures," by N. F. Harpur; *Southampton*, Annual General Meeting and Film Show; *Weybridge*, Brains Trust. Jan. 14, *Boscombe Down*, "Aircraft Control," by Prof. G. A. Whitfield; *Cambridge*, Lecture by W/C. Lewis. Jan. 15, *Leicester*, Main Lecture (see above).

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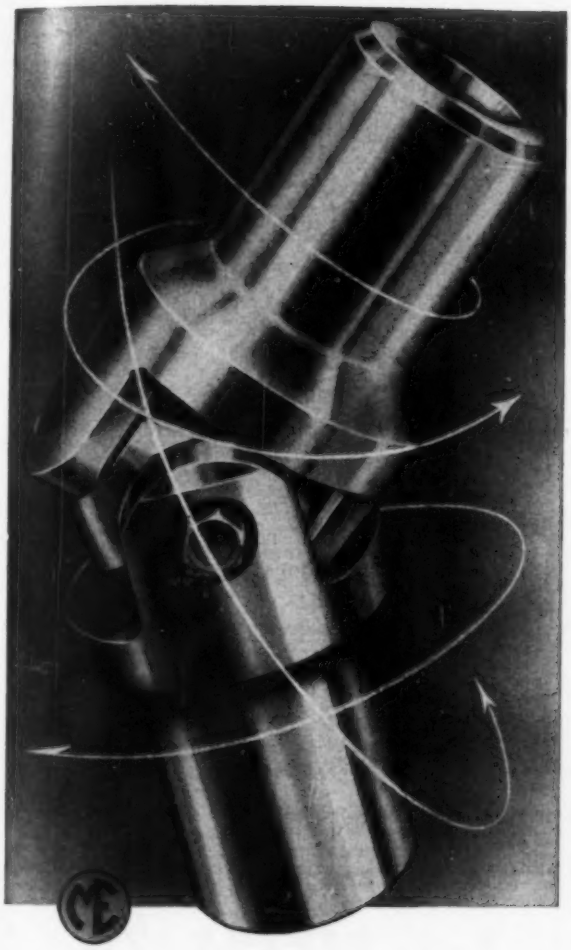

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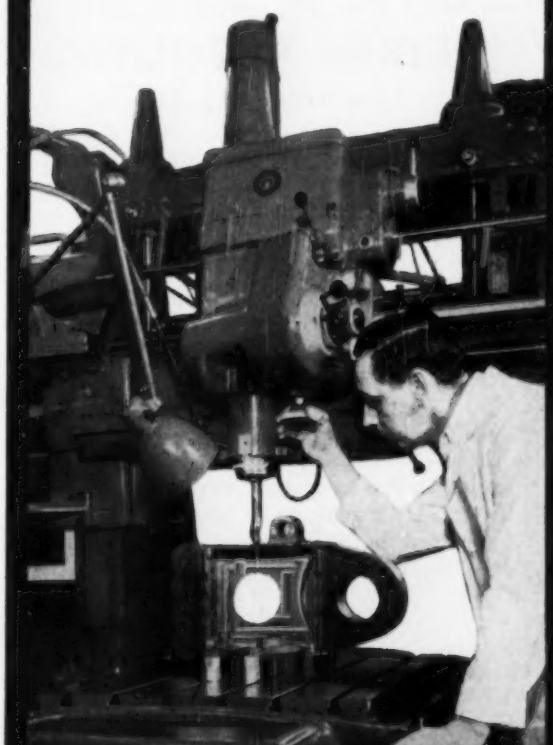

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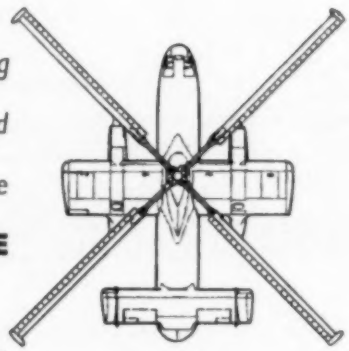

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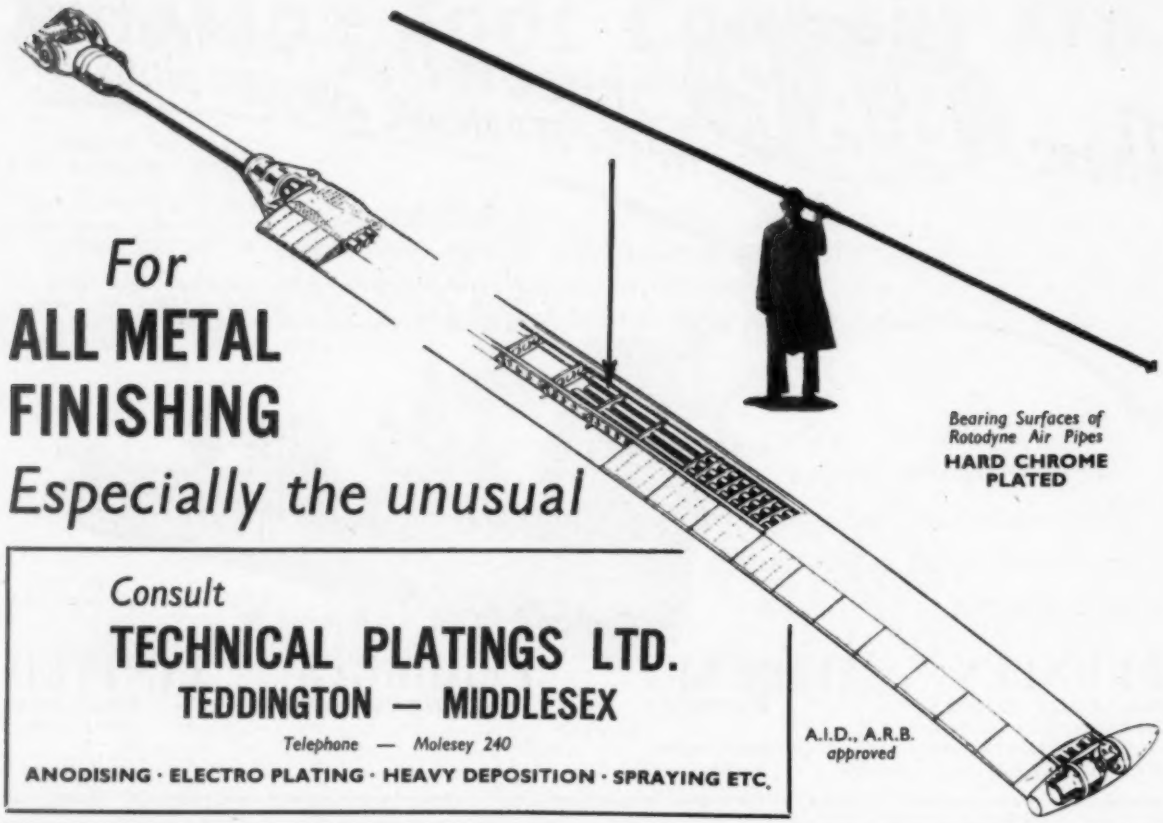

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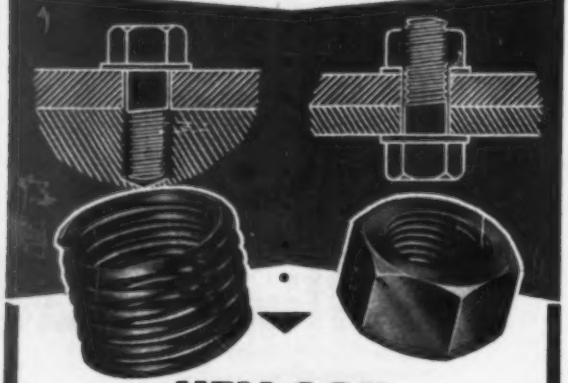

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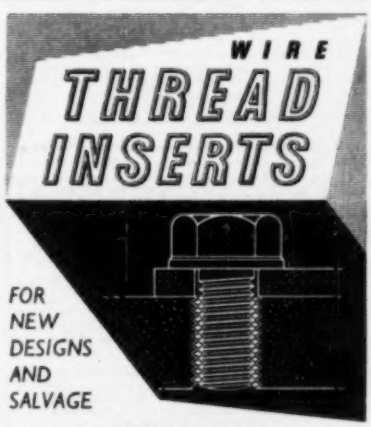

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THIS application will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30, 1952. Any representations or objections with regard to this application must be made in writing, stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3, Dean's Yard, London, S.W.1, from whom further details of the application may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. [7406

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CANDIDATES must be between 21 and 28 during 1957. They must have a first or second class honours degree, preferably in physics or mathematics, or an equivalent qualification. Salaries (London rates), £635-£1,110. Women's pay above £635 slightly lower but being raised to reach equality with men's in 1961. Somewhat lower rates in provinces. Opportunities for promotion to Senior Scientific Officer (£1,190-£1,410), and higher posts.

PARTICULARS from Civil Service Commission, Scientific Branch, 30 Old Burlington Street, London, W.1, quoting No. S52/57 (Met.).

APPLICATION forms should be returned by 31st December, 1957. [7392

SENIOR Scientific Officers; Scientific Officers. The Civil Service Commissioners invite applications for pensionable appointments covering a wide range of scientific research and development in most of the major fields of fundamental and applied science. In biological subjects the number of vacancies is small: individual vacancies exist in the Natural History Museum for candidates who have special knowledge of, or who are interested in, taxonomic entomology, palæontology.

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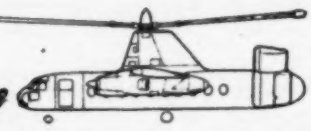

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